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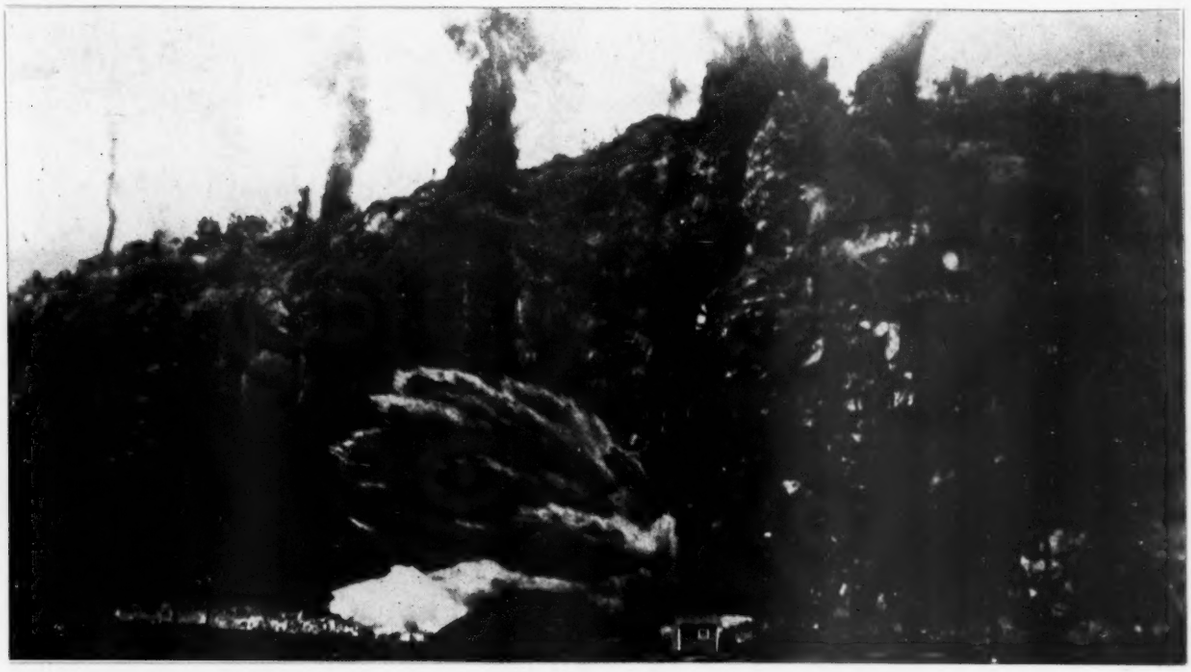

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CORDEAU
DETONATING FUSE
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FEATURE CONTENTS

Next Issue July 20, 1927

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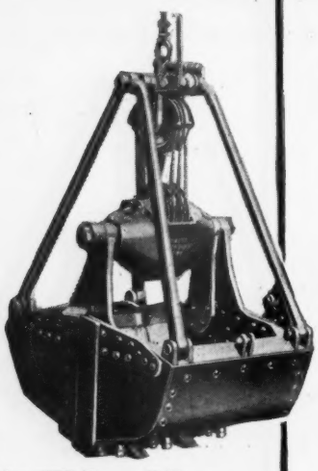

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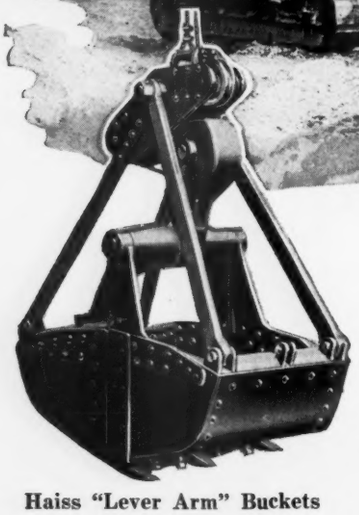

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Pit and Quarry

Vol. 14 CHICAGO, ILL., JULY 6, 1927 No. 7

MEANING OF DECREASED AUTOMOBILE PRODUCTION

AUTOMOBILE production for the United States in May of 1927 showed less than the usual seasonal decline from April. From that standpoint, the matter must be considered as an optimistic development. On the other hand, the total output was only 396,411 cars as against 417,271 in May of 1926. So far, each month of 1927 has been running below the corresponding month of 1926.

However, before accepting the idea somewhat generally held, that the motor industry this year is to run far behind its output of the preceding year, two factors not so apparent on the surface must be considered. These are, first, a marked change in buying habits, and second, the uncertainty as to the Ford plans for the future. Surprising as it may seem, buyers of automobiles are showing a definite tendency to turn toward higher priced and, as a rule, heavier cars. This means that the motor industry is absorbing almost as much and probably entirely as much raw material as it absorbed a year ago, and that it is probably taking in and paying out as much money.

The statement that buyers are taking heavier and more expensive cars is contrary to the widely accepted belief. It is, however, definitely borne out by the figures on new registrations. Analyzing the figures for what can be considered definitely as light cars, brings to light the fact that while in April, 1926, registrations in this class were 71 per cent of the total, in the same time this year they were only 68 per cent of the total.

At first glance, this difference of 3 per cent in demand shifting does not seem important. Further analysis of the light car group, however, shows a much more decided shift of buying habits. In April, 1926, of the 71 per cent output of light cars, 34 per cent were Fords and 37 per cent all others. In April of this year 23 per cent were Fords and 46 per cent comprised the more expensive and generally heavier cars which are included in the classification of "light" cars. It is impossible to put the effects of this tendency into exact figures, but there is little doubt that the total makes a very considerable difference in the amount of material, and it may involve the future of the entire industry.

For more than a month now, the public, including all manufacturers of motor cars, have known definitely that Ford is about to put out a new model radically different from the one which he has carried with small changes through many years. Those in close touch with the industry have, of course, known this for many months, and Ford executives themselves must have known it since at least the first of the year. This factor has had a decided effect upon buyers and similarly upon producers of other makes. While the uncertainty lasted, many buyers have held off to take a look before placing orders. This buying slowness plus the manufacturers' unwillingness to have on hand cars which might be closely competitive with the new Ford model, has produced a conservative attitude in those who budget the output of other model plants.

Even more directly affecting the total output of cars has been the shutting down of Ford producing units and particularly of Ford assembling units, under a definite plan to allow Ford dealers to work off old models before the new model should be placed on sale. The expectations of those fairly close to the Ford management are that the new car will be advertised some time next month; that fairly heavy production will soon begin, and that by early fall the new model will be delivered.

This will affect the general output of cars two ways. In the first place, the public and other makers will be released from present uncertainty. In the second place, the Ford plant itself will be operating at full time to take care of cars for current deliveries and also to build up practically nonexistent stocks in the hands of Ford dealers. This activity will come at a time of the year when output of cars usually is seasonally low. Even in record-breaking production years such as 1923, 1925 and 1926, this seasonal decline was extremely evident. This gives strong reason to believe that July

and August of this year will show a car output at least equal to 1926 in the same months, and very probably it will be heavier.

It will be remembered that November and December of last year showed drastic curtailment of output. Part of this was due to the policy of the Ford company in curtailing stocks in the hands of dealers. The rest was due to the fact that practically all makers produced more cars than they sold in the early fall months of 1926. These new developments render it certain that no such curtailment will be seen near the end of this year, and that the second half of 1927 will see a higher output than the second half of 1926.

THE WEATHER AND FARM SURPLUS

IN recent years, the surplus of farm products has been one of the most vexing economic questions in the country, and it has produced a correspondingly vexing political question. Opponents of political farm relief are constantly pointing out that the farmer created his own difficulties by producing more than he could reasonably hope to sell at a profit. The retort has been that farming is an industry whose output cannot be controlled as can that of a manufactured product.

The last two years were ones of relatively high yields per acre. To a very great extent, it is true that farm surplus in those years was involuntary rather than intentional. So far this year, the crop weather has been distinctly against the expectation of a large output. Winter wheat is already certain to be a short crop. Corn and cotton have had a very bad start. Conditions ranging from soil slightly too wet all the way up to the Mississippi floods have curtailed the acreage and have damaged the prospects of acreage actually planted.

It is one of the oldest public beliefs that large crops make great prosperity. Ordinarily there is much ground for this belief. Bountiful crops mean heavy tonnage for the railroads and relatively low food costs in the cities. The cities, however, have had an undue proportion of prosperity in recent years. The country as a whole has been prosperous. Any drawbacks which existed were in a spotty distribution of this prosperity, with the farmer at the low end of the scale.

From the standpoint of more equitable distribution of prosperity, this prospective decline in crops is anything but pessimistic. Cotton has gone up nearly 5 cents from its low. Corn has jumped from 70 cents to $1. Even the wheat market, which depends more on world output than upon output in the United States, has been definitely strong. Prices have advanced more than crops have declined, and farmers as a whole will get a bigger share of the national income this year than they have for several years. In some unfortunate areas, the farmer will get practically no current income. General farm purchasing power, however, with the high priced corn, cotton and wheat, is certain to show a sizeable increase.

So much for the crop farmers. With a weak hog market, it would seem at first that the livestock farmer is going to slump badly in income. This weak hog market, however, is only a temporary affair. It is principally due to the fact that advancing corn prices have brought about a rapid and early marketing of hogs. As a result, hog marketings later in the year are bound to suffer. The farmers will have fewer hogs to feed, and the competition of fat hogs next fall and winter will be very much less than it might have been had the hog raiser made only his normal marketings this spring.

WHERE BUYING IS NOT HAND TO MOUTH

IT has come to be accepted as a general fact that forward contracts have lost their significance in American business and that practically all buying is for immediate consumption. The orders of the United States Steel Corporation are lower than they have been in the past fifteen years, and some other industries report similar stories.

There is one industry in the United States, however, where the future placing of contracts has exactly the same importance as it always had. That is in the building and construction industry. Incidentally, it is the most important of all key industries which indicate coming business changes. If one had watched the consecutive placing of building and construction contracts throughout recent years and assumed that changes in them would be reflected six to eight months later in general business, he would have come close to a correct appraisal of coming business changes.

Early in 1927, the building contracts, as reported by the F. W. Dodge Corporation, began to fall very considerably behind the similar figures for 1926, and this development kept up for at least three months. Indeed, even now, the total contracts placed for the first six months of the year will probably be somewhat smaller than they were for 1926. Such a situation is bound to be reflected in the general business conditions of the late spring and early summer, and it is being so reflected. Business now is running at a pace somewhat below what it was at this time last year.

Beginning with April, however, new building and construction contracts have been running almost exactly even with the corresponding figures of 1926 and there seems to be a possibility, if not a definite probability, that the figures for June may slightly exceed those for June, 1926.

CRUSHERS AND THEIR COMPONENT PARTS

By Wm. T. W. Miller

CRUSHERS are a vital factor in the production of pit and quarry materials and these machines have never been discussed in complete detail in proportion to their importance.

This is the first of a series of twelve articles concerning the subject of crushers and their component parts. The eleven future articles will be published in the next eleven issues of Pit and Quarry.

Mr. Miller, the author of this series, has had thirty years' experience as a specialist in crushing machinery. For the last twenty-six years he has been employed by Hadfields, Ltd., of Sheffield, England. For the past eighteen years he has been engineer-in-charge of their crushing machinery department. He has studied crushing problems in the United States, Canada, Brazil, Uruguay, Argentine, France, Spain and Portugal.—Editor.

Mechanisms Applied to Jaw Crushers

There is possibly no machine used in the mines and quarries which presents so many mechanical combinations as the jaw breaker and every year that passes adds other varieties to the species. No crushing machine on the Blake principle existed before the year 1858, and between that date and 1896 more than one hundred modifications of the Blake mechanism had been proposed and offered for sale and more than seventy variations had been patented.

The jaw crusher may be said to consist of a rectangular frame with a fixed jaw-plate attached inside at one end and a jaw-stock or lever carrying the moving jaw arranged to swing internally with a crushing movement in opposition to the fast jaw. The frame also supports the bearings for the actuating shaft and contains the mechanism for transmitting the force from this shaft to the moving jaw.

Jaw breakers may be divided into two groups consisting of machines in which the jaw is pivoted above the feed-opening and those having the pivot point below the moving jaw. These two groups may be further subdivided under four classifications. No. 1, Direct-action machines; No. 2, Double-toggle breakers; No. 3, Double-toggle and lever machines, and No. 4, Lever-type crushers. There are a few examples which cannot be brought directly under any of the above classifications.

A careful study of the various mechanisms used for applying the force to the swing jaw will serve to show how little real change is made in the essential mechanism although considerable modifications are introduced in the details. It may also be instructive to compare the efficiency of the various systems and point out some of the defects inherent to certain designs.

Apart from a very few simple forms of construction it is evident that the chief aim of the designer must be to gain greater mechanical efficiency or, in other words, to obtain the utmost crushing force with the least pressure on the revolving shaft from which this force is taken. Whether it is better to place the pivot point below or above the moving jaw is largely a question of the work to be done by the crusher. With the greatest movement at the bottom or outlet-end of the jaw opening it is not possible to obtain the same regularity or fineness of product as when the movement is reversed.

On the other hand, the crushing is freer and the output is greater when the movement of the jaw increases from top to bottom and the smaller travel on the larger pieces permits of a greater concentration of force due to the leverage. It is also desirable that the rate of crushing should increase, for when the broken material reduces in size it occupies a zone in the crusher opening which has less cross-sectional area.

The following examples include machines some of which are now obsolete, but the majority are still widely used and in many cases they will be familiar to all engineers working in reduction plants.

Fig 1 illustrates the jaw crusher in its simplest form. The machine shown was manufactured about 1873 under the title of "Goodman's Improved Crusher." The component parts are few in number and it is difficult to see how they could be further reduced and leave an effective machine.

The moving jaw is directly supported at its lower end on the eccentric shaft from which the movement is derived, and its upper edge bears against a cross-bar in the frame to which it is attached by bolts which permit a rising and falling action combined with a slight roll or side-swing.

No attempt is made to fit renewable jaw-plates or to provide any adjustment to vary the size of the finished product or compensate for wear. The greater portion of the thrust from the crushing is borne by the eccentric bearing and the jaw has a rubbing action so that, on any hard stone, the wear and tear must be considerable.

The Rawson crusher illustrated in Fig. 2 is another early example of the simple mechanism. In this case the moving jaw is pivoted on a fixed center below the crushing outlet and the motion is applied at a point some distance above the feed opening by means of eccentrics. The crushing movement is greatest on the large pieces of stone and diminishes towards the outlet, and in order to obtain any breaking action at the lower edge of

the jaw it is necessary that the pivot center should be some distance below the outlet point.

Whilst this crusher must be classed among the direct-action machines it is certainly an advance on the first example in that a lesser proportion of the crushing strain is carried by the eccentric shaft and the moving jaw has a straight swing without any vertical movement. If the lower pivot bearings were provided with some form of side-adjustment it would be possible to alter the product and compensate for wear on the crushing faces.

Fig. 3 shows a modern example of the direct-action crusher. The swinging jaw is centered above the feed-opening and the crushing force is applied near to the lower end of the jaw. It follows that more than half of the total pressure required to break the stone must react directly on the eccentric shaft and be borne by relatively high-speed bearings. Provision is made to compensate for wear by means of an adjusting wedge fitted into the back of the jaw-stock.

A breaker of this type, particularly in the smaller sizes, will do quite useful work providing that it is not set for too fine a product or on exceptionally tough ore, but it is obvious that the eccentric bearing must suffer very quickly through any abnormal strain on the machine.

The Acme crusher shown in Fig. 4 is probably the best known and most widely used pattern among direct-action breakers. In this machine, which was introduced in England about 1879, the jaw-stock is carried on the eccentric shaft which is located above the crusher feed-mouth.

The travel of the lower end of this swinging jaw is controlled by a single toggle-plate and the movement, commencing with a circle on the shaft center, changes to an ellipse with a gradual reduction in the minor axis towards the outlet end of the jaw. By flattening the angle of the toggle-plate the crushing stroke may be reduced to the minimum at the sizing point.

With this mechanism it is essential, in order to avoid a neutral zone between two reflex crushing movements, that the center-line of the toggle-plate should be level with or fall below the bottom of the moving jaw. It is also advisable that the shaft should turn in such a direction that the jaw-stock moves downwards as it nips the stone near the top of the feed mouth; otherwise there is a tendency to lift the material and hinder its downward travel, which not only restricts the output but also causes extra wear on the jaws.

The crushing action is complex as it is made up of two cycles of movement which overlap to some extent, one-half of the crushing stroke being due to the eccentric movement at the top of the jaw-stock and the other half to the side-swing from the radial toggle-plate.

The upward half-circle of revolution combined with the radial and forward swing of the toggle-plate imparts a crushing movement to the lower portion of the jaw. During the first quadrant of this movement the upper part of the jaw is still moving backward but, in the next quadrant, the whole jaw moves forward bodily. The lower part then commences to move backwards but the upper part continues its crushing stroke through a further ninety degrees. In other words, commencing on the vertical center at the bottom of the stroke and revolving in the proper direction, the four quadrants of movement are as follows: first, crushing at bottom of jaw; second, crushing entire length of jaw; third, lower part of jaw receding, upper part still advancing; fourth, whole length of jaw swinging backward.

This complicated movement creates double reactions on the bearings with the result that wear causes lost motion and it is therefore essential to keep the bearings in good condition if the output is to be maintained.

The rolling action of the swing jaw is also liable to cause heavy wear on the jaw-plates and, on abrasive material, a breaker of the Blake type is generally more economical, but, on soft or semi-hard substances, this Acme crusher will often give better results than a machine in which the jaw has a purely radial swing. The single-toggle mechanism has this advantage over the double-toggle system that there are only half the number of wearing points on the toggle and it is not necessary to adjust so frequently to compensate for wear at the toggle-grooves.

Fig. 5 is an illustration of the Samson crusher, another direct-action breaker working on a similar principle to the Acme. In this machine the single toggle-plate is replaced by two links which pass along the sides to a hinge-pin at the front end of the frame. The lower end of the jaw-stock bears on a second pin resting in journal-boxes which can be moved along the side links. Adjustment is made by means of shims or packing pieces placed behind these sliding bearings and bedding against thrust-collars or shearing pins on the links.

The mechanism is arranged in this manner to eliminate tensional strains from the lower part of the frame. The reaction from the crushing at the bottom of the jaw takes the form of compression on the front end of the frame casting. The crushing action is generally similar to that obtained in the Acme breaker except that, owing to the reversed position of the toggle links, the pinching effort from the link-motion takes effect on the downward half-circle of movement.

The next example, Fig. 6, shows the well-known Blake-motion stone breaker. Invented in 1858 by Eli Whitney Blake, this design remains unrivaled for all crushing units of exceptional power and size, which is a sure indication of the merits of the mechanism.

It is usual to consider this as a double-toggle mechanism but the movement is complicated owing to the fact that the middle hinges of the toggles

are separated by a distance equal to the thickness at the lower end of the pitman or connecting rod, which is equivalent to the introduction of a third toggle in the system.

This third member forms part of the solid pitman casting, which is subjected to a rolling action from the eccentric shaft at its upper end and a radial movement at its lower end on the fulcrum of the back toggle-plate. This middle plate therefore modifies in some degree the true toggle action, although not to such an extent as to greatly reduce the efficiency. The outstanding advantage of this mechanism lies in the fact that the greater portion of the reaction from the crushing strain is taken by the frame of the crusher and only a predetermined amount falls on the eccentric bearings.

Broadly speaking the pressure on the eccentric shaft varies inversely as the ratio between the stroke of the eccentric and the effective movement at the toggle-groove in the jaw-stock. It follows, therefore, that the greater the eccentricity and the smaller the actual crushing stroke the less will be the proportion of the work load causing pressure on the revolving shaft.

If there is one fault in this mechanism it is that the disposition of the moving parts is such that there is considerable dead-weight resting on the eccentric and frame bearings, to which must be added, once per revolution, the heavy load from the effort of crushing. There is, therefore, no momentary relief of pressure to allow the lubricant to pass and it is sometimes difficult to ensure effective lubrication and cool running, especially in the larger machines.

Springs under the pitman and other means are adopted to overcome this constant downward thrust and permit of free passage for the lubricant. In the ordinary Blake breaker the upward or working stroke of the eccentric shaft has not only to break the stone, but to lift the entire weight of the pitman and a large proportion of the weight of the toggles and swing-jaw as well. The Bigelow crusher shown in Fig. 7 was designed to overcome this difficulty and to make the weight of the parts add to rather than detract from the crushing force.

The toggles are inverted and the downward stroke of the eccentric applies the crushing effort so that the weight of the pitman adds to the force of the blow. The jaw-stock hangs vertically with the center of the shaft well forward of the center of gravity of the mass; the weight of this heavy part therefore also assists in the crushing.

The frame is made in two parts with a loose back-piece through which pass heavy tie-bolts, one on either side of the main casting. These powerful bolts relieve the frame from tensional strain and the sides can be made of relatively light section. The tail-piece slides on sole-plates and packings are inserted between the frame and the end-casting so that the tie-rods may be used for adjusting the crushing aperture and compensating for wear, dispensing with the usual wedge-adjustment.

It is sometimes said that the upward thrust is liable to throw excessive strains on the frame-cap bolts but, with heavy fly-wheels and pitman, this has not been found to give trouble in normal crushing operations.

The Schranz breaker shown in Fig. 8 is an example of a Blake-motion crusher with a rolling jaw and is really an attempt to combine the functions of jaw breaker and rolls in a single machine.

The movable jaw works on a central pivot supported by two links hanging from a fixed shaft spanning the frame of the breaker. The crushing force is transmitted from the eccentric through the toggle system to the swing-jaw holder but the rise and fall of the pitman imparts to the moving jaw a downward roll during the crushing stroke and an upward movement on the return stroke. The adjustment is identical with the older form of Blake crusher.

This machine was largely used in Germany, about 1885 to 1890, as a fine crusher reducing to eight millimeters and under, but the wear on the jaw-plates was high and the breaker has fallen into disuse. Among the earlier forms of the Blake crusher is the toggle and lever machine illustrated in Fig. 9. This breaker was introduced by Eli Whitney Blake very shortly after his original invention.

The lever is added to the mechanism to further reduce the pressure on the bearings of the revolving shaft. Assuming the leverage to be five to one, the load on the crank-shaft would be only one-fifth of that carried by the eccentric shaft of a standard Blake crusher with the same toggle combination, the throw of the crank being five times greater than the eccentricity in the earlier machine.

Whilst this combination offered certain mechanical advantage, the lengthening of the frame and the complication of the mechanism made the machine more cumbersome and this type did not find favor for a number of years.

When Marsden was sent over to England by the firm of Blake Brothers he revived this lever and toggle machine in a form approximating to that shown in Fig. 10. At first sight this would appear to be a single-toggle mechanism but a closer examination shows that one of the toggle-plates is incorporated within the lever, forming a pair of inverted toggles.

These machines have been very successful for a considerable number of years but one of the weaknesses in this design is the method of holding the lever in its fulcrum groove. This connection has to be made in such a way as to permit of freedom of movement and allow for adjustment in a horizontal direction to modify the product or compensate for wear on jaws, grooves and toggles.

Another patriarch among the toggle and lever machines is the Hope crusher illustrated in Fig. 11. Although the component parts are the same as in

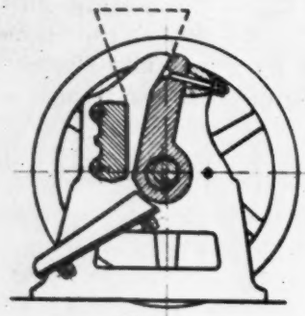
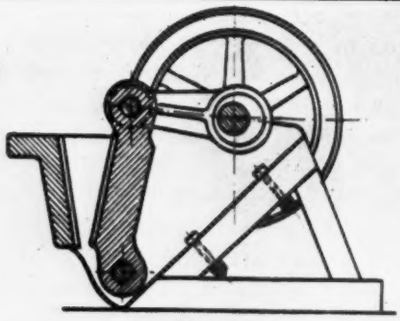


Fig. 1.



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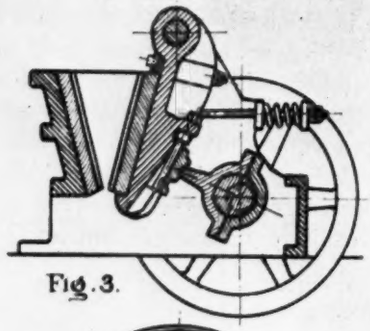

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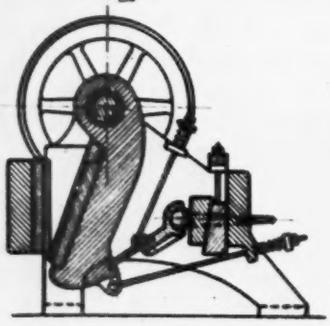

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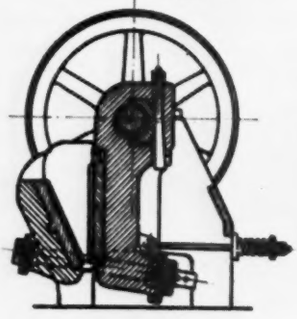

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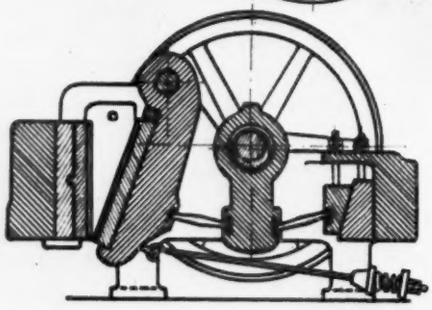

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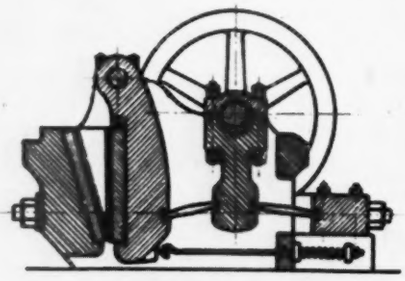

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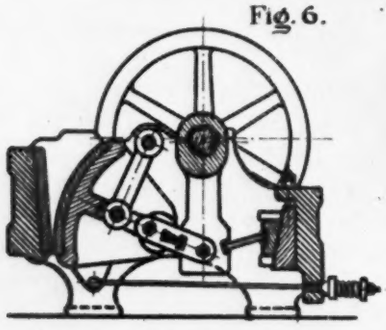

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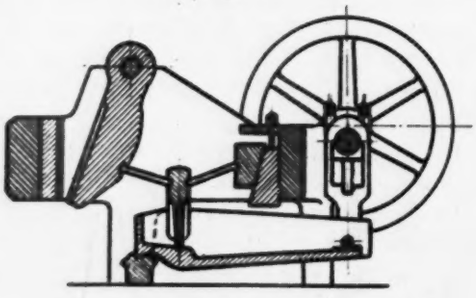

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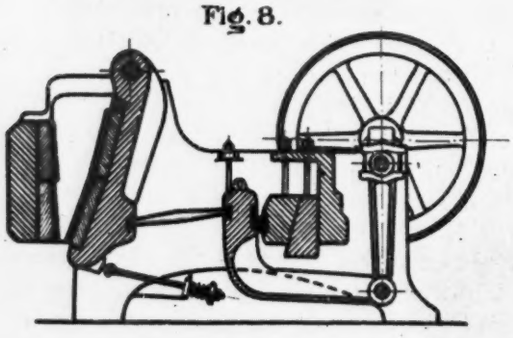


Fig. 10.

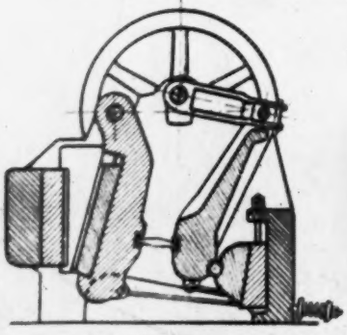


Fig. 11.

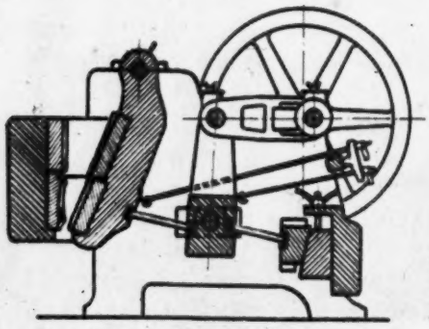


Fig. 12.

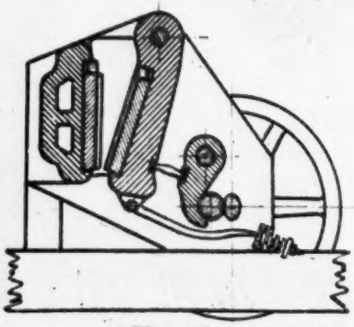


Fig. 13.

the Marsden lever crusher, they are arranged somewhat differently and the machine is more compact. This machine was patented in 1871 and the writer saw one of the early examples still in service a few months ago.

The Baxter crusher, shown in Fig. 12, is said by the inventor to include a combination of three toggles with a lever and connecting rod. It would be more correct to say four toggles, rather than three, as the lower end of the vertical lever, being pivoted on a central shaft or hinge-pin, includes one toggle member on either side of the vertical center-line.

The lever occupies the same position as the pitman in the Blake crusher and it is supported at its lower end on a through shaft carried in rolling or sliding bearings supported in horizontal rectangular recesses in the frame sides. The arrangement of the toggles is peculiar, the object being to obtain a sharp blow at the commencement of each crushing-stroke. It is claimed that the striking speed is double that in any other jaw crusher and that the stone is broken by a hammer-blow rather than a squeeze.

One good feature with this mechanism is the small proportion of dead load carried by the rotating shaft. Only half the weight of the connecting rod bears directly on the crank, all the other moving parts except the jaw-stock being supported by the lever spindle.

In the small sizes, such as are used by road authorities for making macadam, this machine forms a very efficient unit and is capable of doing good work on hard material.

In the following series of three examples a short toggle-plate is used more as a connecting link or as a medium for adjustment than as a means of increasing the efficiency of the combination. This is proved by the fact that any of these machines could be made to operate successfully by removing this toggle, bringing the lever in direct contact with the jaw-stock. These breakers should therefore be classified as lever machines.

In Fig. 13 the leverage is very small, little more than two to one, and half the total pressure exerted at the lower end of the moving jaw must be transmitted through the roller to the cam on the revolving shaft.

In Fig. 14 the leverage has increased to approximately three to one with a corresponding reduction in pressure on the shaft. The lever is disposed to better advantage and is kept in contact with the cam by means of powerful springs. The Ehrsam breaker, shown in Fig. 15, is the third example of the lever mechanism and this crusher has a greater mechanical advantage than either of the two previous types owing to its greater leverage.

It is obvious that there must be an economic limit to this leverage ratio and it should be borne in mind that any undue increase in the proportion of stroke of shaft to crushing-stroke will also cause a rapid increment to the surface speed of the crank in the connecting-rod bearing.

The double cam, which is a feature of the designs shown in Figs. 13 and 14, may be run slower than a crank or eccentric as each revolution of the shaft yields two crushing strokes. The wedge-angle of a cam of this type is, however, considerably more obtuse than in a single-cam or eccentric and the power required must be increased. The three last-named machines are all of the same type, comprising a jaw-stock, with its pivot shaft above the jaw-opening, and a separate lever casting applying the force to the lower end of the jaw-stock. The same mechanism is sometimes inverted to reverse the crushing movement on the swinging jaw, bringing the pivot shaft below the outlet from the jaws as shown in Fig. 18.

This makes a very effective machine for fine crushing. The distance from the center of the hinge-pin to the lower edge of the jaw is greater than the length of the moving jaw, so that there is no excessive disparity in the stroke from top to bottom of the crushing chamber, and this helps to prevent choking and permits of a small movement which insures uniformity of product. In some cases the jaw-stock and the lever are combined in one casting and the Dodge breaker, shown in Fig. 16, is the best-known example of this type of construction.

In this machine the lever is pivoted below the outlet from the jaws, the fulcrum-shaft being carried in slide-blocks which are adjustable in recesses in the side-frames. The distance from the pivot center to the bottom of the moving jaw is relatively small and the crushing movement at this point is restricted. The leverage ratio is however greatest at the bottom of the jaw and decreases as the stroke increases towards the top of the jaw-plate. This breaker is designed on the assumption that the greatest force is necessary for the finest crushing, which may be correct if packing takes place but is hardly true for free breaking.

For medium-fine crushing this type of breaker presents certain advantages. The curtailment of the stroke at the bottom of the jaw gives greater regularity of product. Its great drawback is that wear on the pivot-bearings creates lost-motion which quickly neutralizes the small movement at the bottom of the jaw and, unless corrected in time, seriously restricts the output from the machine. Some makers try to reduce this lost-motion by attaching the draw-back springs to both ends of the hinge-pin with the object of keeping it hard against the bearing seats in one direction, but such springs are rarely effective in practice.

It has long been recognized that it is desirable to sort out and remove from the product as quickly as possible any particles which are reduced to the requisite degree of fineness in the early stages of the crushing operations. This fine material fills the voids and hinders free crushing; it

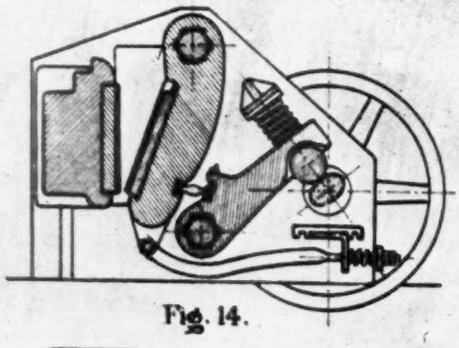


Fig. 14.

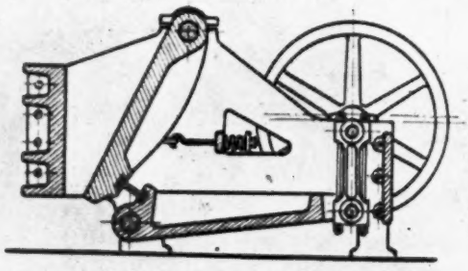


Fig. 15.

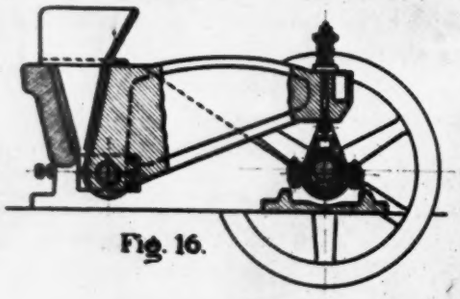


Fig. 16.

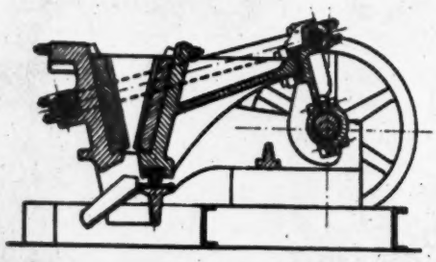


Fig. 17.

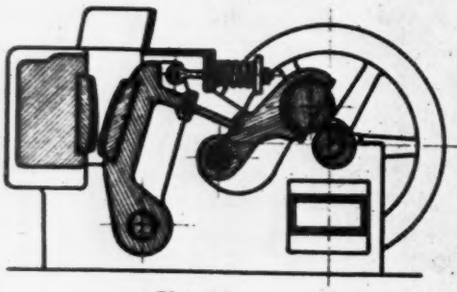


Fig. 18.

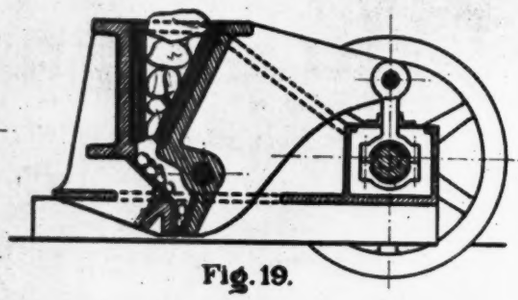


Fig. 19.

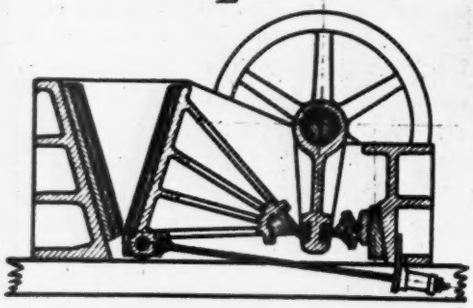


Fig. 20.

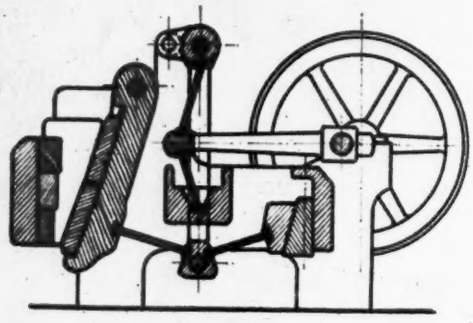


Fig. 21.

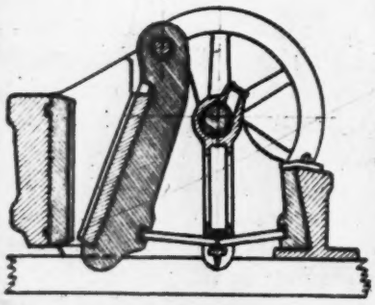


Fig. 22.

Fig. 23.

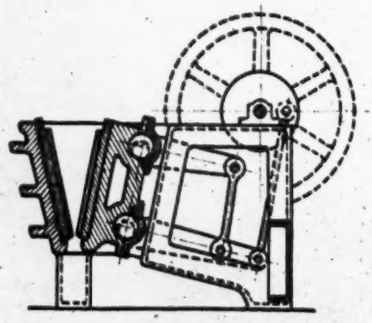


Fig. 24.

also causes packing and high power consumption, and if a granular product is desired, the attrition between the compacted particles increases the proportion of dust and destroys the angularity of the crushed material.

The breaker shown in Fig. 19, which is the subject of a recent patent application, is worthy of notice as one of several attempts to combine in a single machine the principle of double-stage crushing with intermediate screening. This is really two crushers in one, both being true lever machines of the Dodge type, the upper or coarse breaker having its pivot center below the jaws whilst in the lower or fine crusher the moving jaw is hinged above the feed-mouth. Between the primary and secondary crushing operations the material is screened by passing over a perforated chute-plate.

Notwithstanding its crudities the design shown has some good features. It is a continuous crusher. There is no idle return stroke. When crushing ceases between the upper pair of jaws it commences immediately between the lower jaws. The mechanism is simple and there are few parts to get out of order.

It is evident that the bearings for the connecting rod and eccentric shaft will have to be kept in good condition so that the clearance is reduced to a minimum. With opposing reactions from the double crushing excessive clearance would cause a "knock" which would be extremely detrimental to the bearings.

The machine shown in Fig. 17 includes a combined lever and link mechanism arranged to give two crushing strokes, or perhaps it is better to say two half crushing strokes per revolution of the shaft, as the top half of the moving jaw advances while the bottom part recedes.

The mechanism consists of two connecting links, one on either side of the frame, which are hinged on a fixed shaft or cross-bar at the front end of the body-casting so as to swing vertically above the eccentric shaft. The free ends of these links are joined by a shaft which serves a dual purpose as coupling-pin for the connecting-rod and as the fulcrum when the latter is called upon to act as a lever.

This connecting-rod is supported by the eccentric and to it is attached, a short distance below the fulcrum-pin, the lifting end of the lever carrying the moving jaw. This jaw-lever bears a family resemblance to that in the Dodge crusher but instead of oscillating on a fixed pin below the outlet from the jaws, the fixed pin is replaced by a roller free to move in a horizontal plane.

The resultant movement is a complicated one. The downward half-circle of rotation of the eccentric pushes the jaw-lever and jaw forward at the bottom, the roller moving freely on the bed-plate. The same downward stroke draws the moving jaw backwards at the top, the jaw-lever radiating with the moving roller as a pivot.

The upward half-circle of rotation reverses these movements, causing crushing to take place at the top of the jaw with the result that the intermittent crushing-strokes overlap to some extent and occur at shorter intervals so that breaking is practically continuous.

The mechanical advantage of this mechanism is a variable one. The connecting-rod carried by the eccentric bearing has a definite leverage ratio of about three to one but this is not effective at all portions of the stroke. The casting supporting the moving jaw has also a certain leverage value but it is very doubtful whether this is made use of to any great extent. The opening between the jaws can be adjusted by means of packings or shims placed between the fixed shaft at the front end of the frame and the body-casting.

The Marathon crusher, shown in Fig. 20, would, at first sight, appear to be a combination of the Blake and Dodge mechanisms. In this case, however, the hinge-pin for the lever is not confined in fixed bearings but in slide-blocks or rollers free to move horizontally but not vertically and, in this respect, the mechanism is similar to that in Fig. 17, with the exception that the pitman and toggles replace the eccentric lever.

The movement of the swing-jaw may be said to comprise a horizontal slide or change of position due to the forward pressure from the closing toggles, the travel being multiplied towards the upper end of the jaw by the radial action around the fulcrum-pin. The movement is such that both the upper two-thirds and the lower two-thirds of the moving jaw are crushing alternately once per revolution of the eccentric shaft. The crossing or overlapping of the two crushing strokes insures an effective breaking motion near the center of the jaws, which would otherwise become a neutral zone.

The resulting total movement gives a freer crushing stroke at the bottom of the jaw than in the Dodge breaker but it is doubtful whether this advantage is not outweighed by the complication of the mechanism and the greater length of the frame.

Fig. 21 illustrates an early attempt to obtain twice the usual double-toggle efficiency with a consequent reduction of pressure on the crank-shaft, and at the same time gain the advantage of two crushing strokes per revolution. The vertical toggles are designed to operate equally on both sides of the center-line with the result that the pitman rises and falls twice for each complete turn of the shaft. This machine did not come into general use and the multiplicity of its parts was most probably the cause of its failure. The rolling toggle system as adapted to Blake crushers has been brought rather prominently before the mining world during the last few years.

Fig. 22 shows an early application of this system as covered by Swedish patent No. 12630 in the year 1901.

The toggle-plates butt together in the center, rolling on curved faces of special shape. Theoretically there is only line contact between the ends of the plates and the bedding surfaces, and in any case the frictional area must be less than with the usual bulbous-ended toggles working in semi-circular grooves.

It will also be noted that the intruding third member formed by the lower part of the pitman is missing from this combination. Assuming that the material from which the toggle-plates are made is sufficiently hard to resist deformation due to the high pressure on a limited area, the loss by friction must be less than in the older toggle system.

The Mjolner crusher (the name of this breaker is obtained from ancient mythology, for Mjolner is Scandinavian for "the terrible hammer of Thor"), shown in Fig. 23, resembles in many respects the Hope crusher illustrated in Fig. 11. In this instance, however, the toggle mechanism is abandoned in favor of a direct pinch-bar action with the intervention of a friction roller between the toe of the bar and the bottom of the jaw-stock. In this machine the leverage ratio is high and the throw of the crank correspondingly great. The parts are simple. Adjustment for size of product is made by introducing or removing shims between the fulcrum bearing-block and the rear end of the crusher frame.

Fig. 24 shows another novel mechanism recently manufactured in Norway. In this machine the container for the moving jaw is carried on two eccentric shafts which are connected by levers and links so as to operate in unison. One of the levers is extended and coupled to a revolving crank-plate by means of a connecting-rod. The oscillation of the levers causes partial rotation of the eccentrics which swings the jaw-holder forward and downward with a parallel motion which is reversed between each half-circle of rotation of the crank.

When the lengths of the various levers are compared with the small throw of the eccentrics it will be found that the leverage ratio is considerable. In this breaker the tensional strains from the crushing reactions are confined within a small area at the front of the machine. It is therefore possible to make the frame in two sections, the front part being of cast steel whilst the lighter framework, carrying the revolving shaft, pedestals, and crank plate, is made of cast iron. No means are provided for adjustment except by packing behind the jaw-plates.

The examples quoted in the foregoing remarks by no means include the whole of the many varieties of mechanism used in the construction of jaw breakers. In a great many instances the family resemblance between machines covered by different patents is so strong as to cause doubt in the novelty of many inventions. The older designs are revived from time to time under new titles and in some cases, with improved materials, they are made into efficient machines. It is well, however, that engineers should study the underlying principles of the mechanism which may lead to success or failure and this small collection is presented to encourage comparison which should lead to better understanding of the merits of the various designs.

County Highway Officials to Co-Operate with Road Builders

The speedy and economical marketing of farm produce was one of the cardinal objectives of a new national organization of county highway officials organized at Washington on June 17th, as a division of the American Road Builders' Association, to stimulate and standardize local road construction throughout the United States. It will be known as the County Highway Officials' Association, and one of its immediate functions will be the arrangement of a program for a county officials' day in connection with the annual convention of the American Road Builders' Association scheduled for Cleveland the week of January 9th, 1928. Road builders from all sections of North, South and Central America will attend the latter meeting, the registration at which will probably exceed 30,000.

The County Highway Officials Association will fill a need of long standing in highway circles of the country. Approximately $600,000,000 is expended each year in local roads, with no uniform code governing the methods under which this enormous sum is distributed. Various committees to be created by the new organization will unquestionably reduce great losses experienced in the past from faulty engineering, and at the same time produce a larger and more efficient system of secondary roads. These committees will report at the annual Road Builders' convention.

Nicaragua Spends $120,000 for Roads

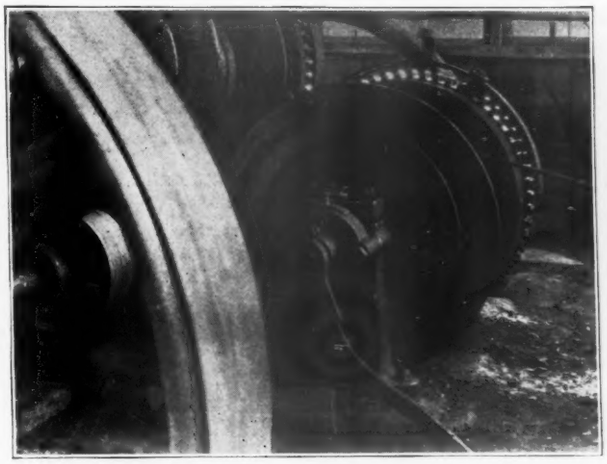
Nicaragua made more progress in highway and street construction in 1926 than in any previous year, in spite of internal disturbance and shortage of money. Although no new road construction was undertaken, resurfacing was done on two important roads: that from Managua to Matagalpa, and that from Managua to Jinotepe. The total spent on this work during the year was $120,000. It is hoped that the surfacing done is of a character to last through the wet season without being destroyed; in which event work can be begun in the next dry season where it is being left off at present with the expectation of sufficient progress being made to make these roads practicable for automobiles throughout the entire year.

MARKET CONDITIONS RESULT IN CHANGES FOR CONNECTICUT AGSTONE COMPANY

By F. A. Westbrook

THE Connecticut Agstone Company of Danbury, Connecticut, is an old operation which under progressive management has changed its output to meet market conditions. Formerly it was a lime burning operation but now it is essentially a crushed stone plant. The growth of the towns, the extension of state highways and the improvement of private driveways, all attributable to the automobile and the widespread prosperity, and the widespread use of concrete construction are largely responsible for this change in operation.

The products of the plant are crushed limestone of various sizes for road work and for the making of concrete sewer and culvert pipe, agricultural lime and three sizes of chicken grit. The amount of waste stone is thus small, as most of the quarry stone is suitable for some of the products turned out by this plant. This tendency to a diversity of products is noticeable in New England, where the non-metallic mineral industry is very active and where profits from the various limestone operations have in many instances shown a decrease, except where some such corrective measures have been taken. It is evidently a part of the industrial renaissance which is taking place in New England.

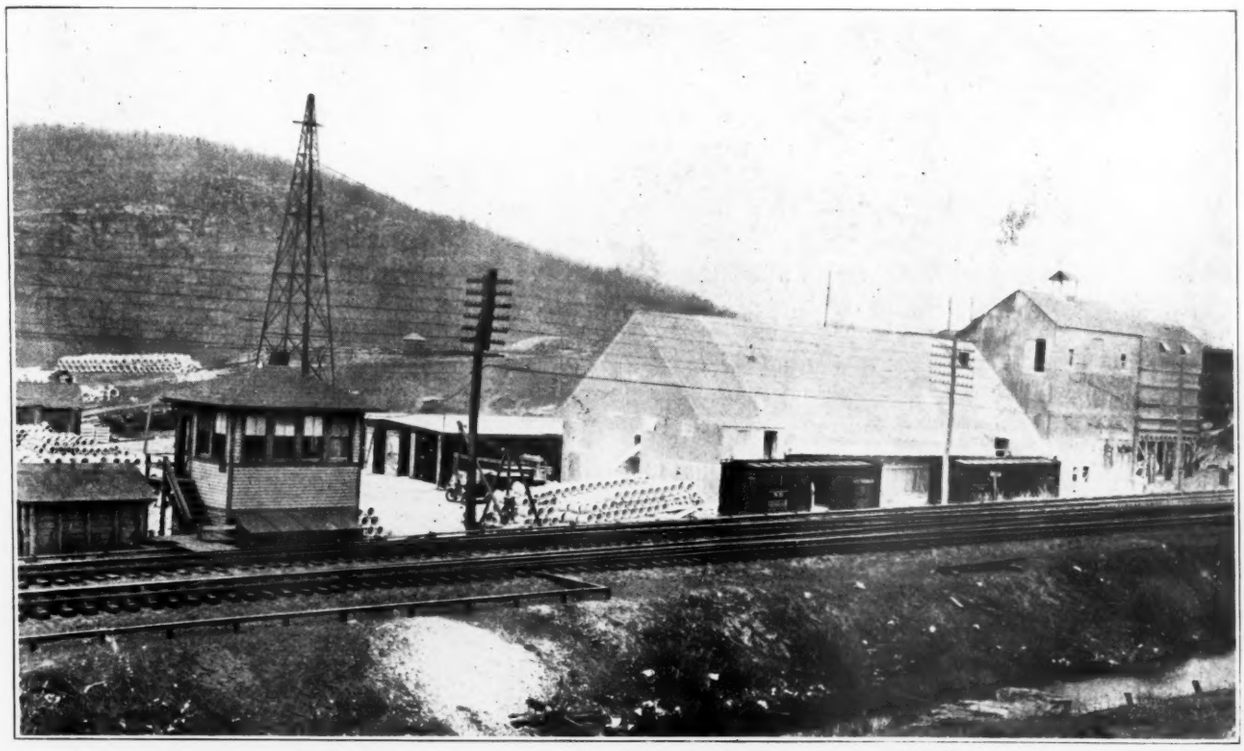


Partial View of the Hoisting Engine

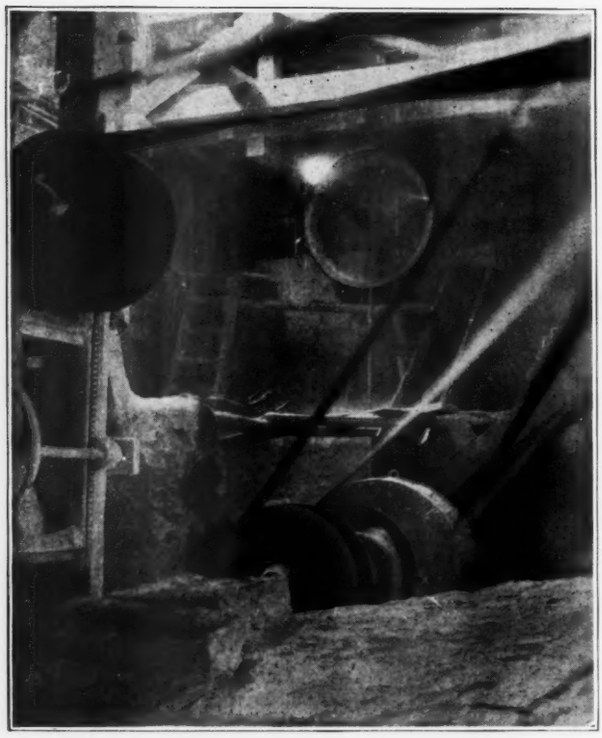
Details of Quarry

The quarry is located a short distance from the plant and as it has been worked for a good many years is a large one and rather deep. At the present time stone is being taken out on two levels. In fact there are actually two quarries which are rapidly being brought together. The stone from the upper level is picked over and sent down a chute directly into a quarry car stationed below. Some of the cars are of the Watt Car Company type and others have been obtained from the Atlas Car and Manufacturing Company.

The manufacturing plant is separated from the quarry by a hill so that it is necessary to haul the



View of the Plant Showing Close Proximity of Main Line Railroad



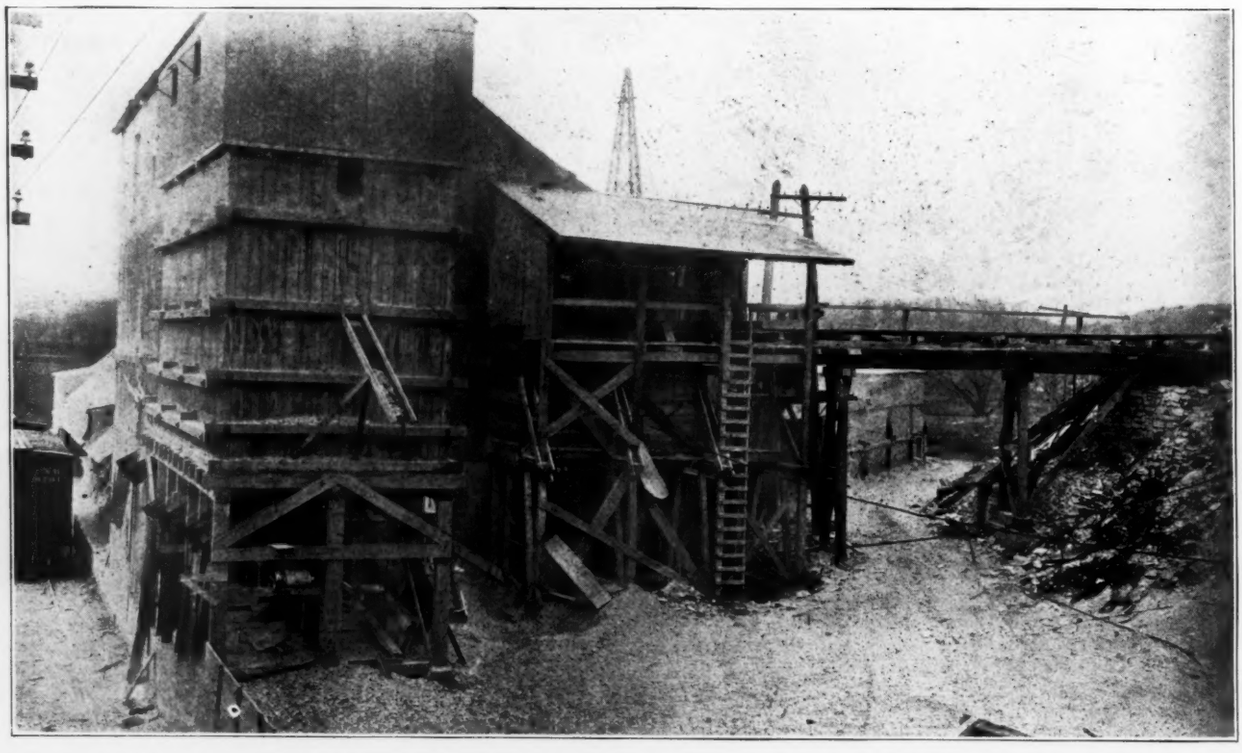
Disc Crusher in Foreground, Jaw Crusher in Upper Background

cars, loaded with stone, up an incline to the top of the hill, where the hoisting engine house is located. The cars then descend a slight grade to the primary crusher. The hoist is a Lidgerwood, which has been converted for motor drive and the wire rope was made by Roebling. The manner in which this rope is used to pull the cars up from the quarry, permit them to coast down to the mill and then pull them up again and allow them to coast back into the quarry without unhitching the rope, is an interesting detail of the operation of this part of the plant. This is accomplished by means of two sheaves located at the apex of the hill, the rope passing around one sheave when the car is on the up grade from the quarry and automatically changing to the other sheave as the car passes to the down grade to the mill and vice versa.

In the same building with the hoisting engine is located a 10x10 inch Ingersoll-Rand air compressor. This is driven by a Westinghouse motor and the hoist is driven by a General Electric Company motor. In this building is also an air tank provided with a New Haven pressure gauge, Ingersoll-Rand jack hammers and a Denver (many hammer) drill which is used for drilling the rock. Forty and 30 per cent DuPont gelatin dynamite is used for blasting, which is done every day. The fact that all of the stone is crushed makes it possible to use higher powered explosives for blasting than is ordinarily done where the stone is to be burned in kilns and where too much shattering is undesirable. In other words, with the processes carried on at this plant the explosives help to reduce the expense of both drilling and crushing.

Crushing Plant

This portion of the plant has been fully equipped with modern labor saving machinery. In some respects the amount of automatic conveying machinery is rather unusual, as will be noted in the following description. The stone is dumped from the quarry cars at one end of the mill into a Link-Belt pan conveyor which discharges into a number 4½ Champion jaw crusher. The stone then drops by

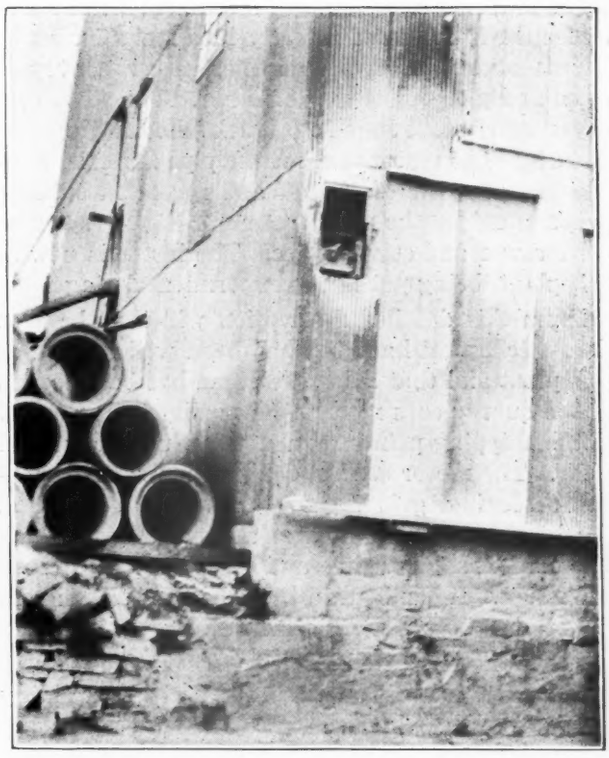


Tracks from Quarry Leading into Cruhsing Plant. Primary Crusher is under the Shed at Right and Storage Bins at Left.

gravity to a Symons disc crusher. The material is next carried in a Link-Belt elevator to hoppers at the top of the building from which it is fed in either one of two directions.

First:—The crushed mixture drops into a Link-Belt rotary screen which takes out the dust, ⅛ and ¼ inch sizes. Under this screen is a shaking screen to remove dust from the ⅛ and ¼ inch sizes. These three grades are dropped into separate bins. The over-sizes from the rotary screen are carried on a short belt conveyor to a second rotary screen which separates the ½, 1 and 1½ inch sizes and drops them into their respective bins.

Second:—By reversal of the chute at the head of the main elevator all coarse material, after the foregoing sizes have been separated, is carried over another Newaygo screen into a bin and feeds the Bradley mills which are located directly beneath the screen. These mills are capable of producing twelve tons per hour and supply pulverized material for agricultural limestone, fillers of various degrees of fineness, etc. Underneath all of these bins travels a 14 inch Link-Belt conveyor and makes it possible to lower or exhaust any bin by carrying the product to a set of crushing rolls from which, in turn, the material is carried to a set of Hummer screens by an elevator, to the peak of the building, near the roof, where the material is separated into various smaller sizes for chicken grit, cast stone and dust. This in turn is carried by another belt conveyor to a set of bins arranged for the storing of material which is used in the making of concrete pipe; the finely ground dust going into the agricultural limestone storehouse. From this storehouse this fine material, whether from the Bradley mills or from the Hummer screens, which has been dropped into the storehouse, is removed by a Link-Belt screw conveyor, located beneath for the whole length of the storehouse and from the conveyor to an elevator which feeds the bagging machines at the opposite end of the building. The material from the bagging machines is loaded into cars, in bulk through a Richardson scale, or in bags



End of Screw Conveyor Used for Loading Freight Cars on Company's Siding

View of Quarry Tracks to Working Face and Chute from Upper Bench

through a Bates bagger, by mechanical means. The bulk lime is delivered directly into freight cars by means of one of two Link-Belt screw conveyors laced at right angles to each other. The other conveyor carries the lime into trucks discharging into a chute. The material from the pipe material storage bins may be drawn off and mixed in suitable proportions for the manufacture of high-grade concrete sewer and culvert pipe. The latter is new at this plant, being yet in the experimental stage.

From this detailed description will thus be seen that mechanical handling has been well applied at this plant and that after the stone has been loaded in the quarry cars mechanical mediums transfer it to the shipping points without any further manual labor. The motor control equipment for the crushing, screening, grinding and conveying equipment has been centralized in a small room from which this equipment is visible and where it is protected from dust. It can be said that the installation represents the best modern practice.

The plant is located adjacent to the New York, New Haven & Hartford Railroad and has a siding for the loading of freight cars. In addition to the screw conveyor for loading bulk agricultural lime, there are also chutes from the various stone bins by means of which trucks may be loaded. The buildings of the plant are made with concrete beams and metal sheathing so that they are not only substantial but also neat in appearance. A Fordson tractor is used for heavy work about the plant, and a Howe truck scale is conveniently located for weighing truck loads of stone when material is shipped in that way for local consumption.

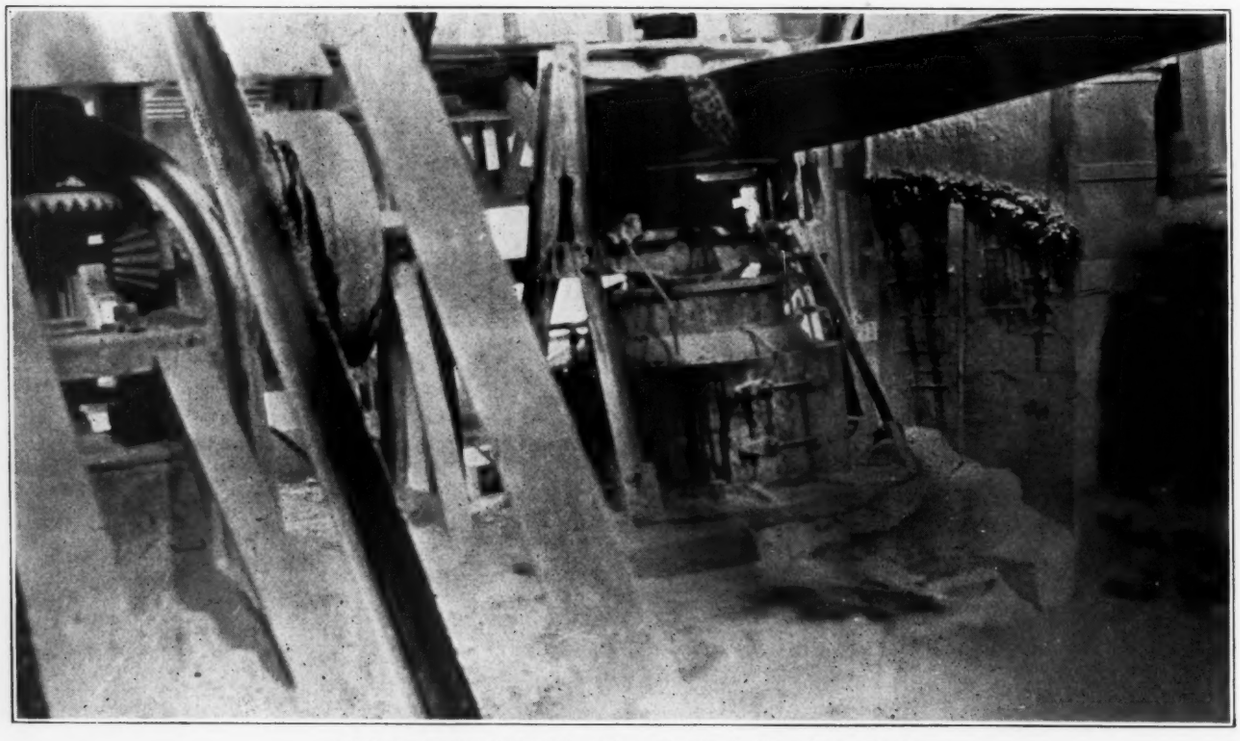
Road Builders Busy in Florida

The State of Florida is spending $17,000,000 annually on roads, while the total amount spent annually by the counties is greater. St. Augustine is now completing 160 miles of good roads which are being built under a bond issue of $2,200,000, authorized by St. Johns county of which St. Augustine is the county seat. These roads will connect with through routes entering Florida from the north and west.

The newly completed Ocean boulevard skirts the Atlantic ocean from St. Augustine to Columbus inlet, eighteen miles south of Daytona Beach, a distance of 68 miles. The boulevard will be built north skirting the beach to Pablo beach, opposite Jacksonville, a distance of 40 miles.

Three new roads are being opened from St. Augustine to the St. Johns river eighteen to twenty-five miles distant. They divide into five roads before reaching the St. Johns river. The Mill Creek highway extends west to Orangedale where a two mile bridge costing $500,000, will be built across the St. Johns to Green Cove Springs, which is reached through Lake City by motorists entering Florida at Lake City or from the west.

A boulevard will run from Jacksonville along the St. Johns river for about fifty miles south to a point five miles north of Hastings. New cross country roads reaching the St. Johns river from St. Augustine will make it possible to leave the St. Johns river boulevard for St. Augustine and complete the loop to Jacksonville by the ocean shore. The new Dixie highway is almost completed between Jacksonville and St. Augustine.



Mill for Pulverizing Limestone for Agricultural Purposes

TREND OF PRACTICE IN WATER PURIFICATION

By Paul Hansen
Pearse, Greeley and Hansen*

IT SEEMS to me that the outstanding development and event in connection with water purification in recent years has been the acceptance of a standard of purified water. That standard is what is known as the United States Treasury standard. It demands now, according to the latest revision of that standard, not more than one B. Coli per 100 c.c. in the purified water. That has done more than any one thing to crystallize and define water-purification practice.

Degree of "Permissible" Pollution

Another thing it has done, and one which you will hear a great deal more of in the future, is that it has enabled us to secure a knowledge of the degree of pollution that is permissible in raw water. The first expression of that degree of pollution was given by a committee of experts called in by the International Joint Commission on boundary waters. On the basis of statistical evidence, they expressed the opinion that raw water should not contain more than 500 B. Coli in 100 c.c. Water more polluted than that was too polluted to be purified. Later on there was an investigation by Streeter, of the United States Public Health Service, who made a statistical study of some twenty-five water-purification plants, involving filtration and sterilization, in the central west. These statistics were presented to the Journal of the American Water Works Association, and showed that there was a definite relation between the quality of raw water and the quality of filtered water, and indicated that the pollution of the raw water should not exceed 650 B. Coli in 100 c.c.

Streeter pursued his studies further by making an extensive study of some ten water-purification plants on the Ohio River, and by building an experimental water-purification plant at Cincinnati. These further studies indicated that filtration alone could not handle water successfully and produce an effluent equal in quality to the Government or "United States Treasury" standard. With liquid-chlorine sterilization following filtration, it was possible to successfully purify water with a B. Coli bacilli content of from 5,000 to 6,000 in 100 c.c.

Where plants were elaborated to include double coagulation and double sedimentation, filtration and sterilization, it was possible to handle raw water containing about 10,000, or possibly more, B. Coli bacilli in 100 c.c. And if we would still further elaborate the process so as to include secondary filtration, possibly of the slow-sand type, and so on, we might be able to handle water containing as high as 50,000 B. Coli.

*Presented before the Canadian Section, American Water Works Association.

Co-ordination Between Water Purification and Sewage Treatment

Now all this raises the interesting question of how far we are going to go in permitting the use of polluted water and how far we will have to go in the elaboration of our water-purification plants to meet that pollution. Also what are we going to do about limiting the pollution of streams by requiring municipalities to put in sewage-treatment plants? In other words, the time has come when many of the streams, both in the United States and Canada, are being polluted to such a degree that we have got to consider co-ordination between sewage treatment and water purification.

Just what that co-ordination will be, is something that will have to be given a great deal more thought and study. At the present time, there is no crystallization of opinion on this subject. The general impression seems to be that we cannot go on indefinitely elaborating water-purification processes, and that there comes a time when the esthetic sense of the community rebels against pollution in raw water.

Another matter that we have to consider is how efficient purification plants may be in removing that pollution.

At Albany, N. Y., water pollution became so great that they had to elaborate their purification to include preliminary chlorination, coagulation, sedimentation, rapid sand filtration, slow sand filtration, and finally sterilization. Even though they were able to produce safe water, public sentiment has condemned the system, and has demanded expensive measures to lessen the pollution.

It is generally difficult to co-ordinate sewage treatment and water purification, because there is no adequate central control governing the two things. Usually the municipality upstream pollutes the water supply of the community downstream. They are usually not disposed to put in sewage-treatment works until the community in the downstream direction forces them to do so through the activity of some state agency.

There are a few cases where a group of communities may undertake to consider economical co-ordination between sewage treatment and water purification. That situation applies largely to cities taking their water supply from the Great Lakes. These cities generally discharge their sewage into the lakes and obtain their water supply from the lakes. They have what you may call the rotary system.

Comparative Costs of Water Purification and Sewage Treatment

It is necessary sometimes to purify both the sewage and the water supply, and the question arises as to just what it is economical to do. Sometimes municipalities on a given stream may group together in order to handle these inter-related problems.

In order to leave a few thoughts with you on this subject, I might mention that sewage purification as a means of protecting water supplies is generally more expensive than water purification. Broadly speaking, complete sewage treatment which produces a clear effluent will cost not less than $9 per capita, and may cost more than that, whereas water purification will probably not cost more than $4 or $4.50 per capita. The most elaborate process of water purification will cost not more than $10 per capita. It would seem at first blush as if the tendency should be towards water purification as being the cheaper method of securing the best result, and it is more or less an open question as to which one we are going to hear a great deal more about in the future. It is about time we began thinking of it more seriously.

Another series of items that I would like to consider are in connection with the details of design and operation of water-purification plants.

Advances in Filtration Plant Operation

There have been a great many advances in the chemical treatment of water, but I merely want to say that Norman J. Howard, of Toronto, has contributed as much as anybody to the knowledge of the use of chlorine in connection with water purification.

There have been some advances in the method of using coagulation, more particularly with reference to the control by means of observing the hydrogen ion concentration of the water. It has proved to be a perfectly practical method of maintaining control over the application of coagulant.

Another question that is confusing the minds of water works men is the matter of the preliminary treatment of water with coagulant. It is generally recognized that after coagulant is added to the water, it must be thoroughly mixed. There must be an intimate mixture of the chemical with the water. There is no agreement on just how that mixture can best be obtained—whether by waterfall effect, exemplified by the hydraulic jump, or by a stirring device, or by a baffling arrangement; nor is there an agreement as to the length of time. There seems to be a tendency of opinion in water-purification practice to consider that the important thing is to get a thorough intimate mixture at the start, and that the subsequent mixture is not important. Nevertheless, it is probably that there should be a continued mixing of a gentle sort, but for just how long a period is not clearly known; probably from ten minutes to half an hour, but it actually takes longer than that sometimes for coagulation to form. However, it is not of vital importance in securing results.

Then we have sedimentation. There is quite a little to be learned about this. It has generally been by guess, and varies from two hours to six hours. We do not know just what period is necessary. It varies with different waters. There is much to be learned in the shape and arrangement of the basins. Generally we have departed from scientific processes in designing these, in favor of economic construction.

It has been found that double coagulation and double sedimentation is very efficacious, and greatly increases the efficiency of the filtration works and at the same time permits economy in the use of the coagulant.

Then there is the question of dealing with very muddy water, and the removal of sediment. Generally it is done in a sedimentation basin equipped with devises for removing the sediment as rapidly as it forms. That is not a matter that concerns you much in Canada, except in the central west, but it is very important in some of the very muddy middle-western streams of the United States.

Improvements in Under-Drain System

In connection with filtration, attention has been given to the importance of the under-drain system. There has been practically no change in the general design of filtration units, nor is there any contemplated, but a good deal of effort is being made in trying to improve the under-drain system. One of the important advances in that connection is the cementing of a gravel layer in the bottom of the pit. That was first done by William Gore, at Oshawa, Ont., and has apparently worked very successfully there. Following that, Mr. Jenks, in Sacramento, Calif., devised an under-drain system composed completely of cemented gravel. He cemented the whole business; Mr. Gore only cemented the upper layer. Jenks used vitrified pipe. Lime is used at this place as one of the chemicals for the purification of water.

A good many of the troubles that have resulted from filtration can be ascertained by an examination by microscope, and it is probable that with the proper use of chlorine it will be possible to control the condition of the sand grains so that they will always be in operation. That is something that will greatly improve filtration during the summer, when filtration is most subject to short-run trouble, due to clogging with organisms.

Characteristics of Filler

Then some thought is being given towards a better understanding of the function of the sand. We have gone along somewhat blindly for a number of years, using sand in a treatment as first de-

vised by Allen Hazen, but I cannot see that there is any reason yet for changing. We have to study the characteristics of the sand from a slightly different angle than did Hazen in 1890. An effort is now being made by filter operators to determine the characteristics of the sand, not as a whole, but as it lies in layers in the sand bed; and they are taking samples at different levels, and examining that sand so that they can express its characteristics by a chart which shows the size of the grains at various depths. That may prompt us to some modification in the sand that will make for efficiency and economy.

Another thing that is being thought of in recent years, and that will be considered a great deal more in the future, is the improvement in the quality of concrete used in water-purification plants. As a rule, water-purification plants call for a very high grade concrete—the very densest. That has not been given so much care as it should have been given, with the result that some plants are disintegrating, especially near the water line, and especially where you have frost on one side and water on the other. There is a tendency now in specifying the concrete to require the use of the cement-water ratio as a means of securing a definite kind of concrete.

Cost of Water Purification Plants

Now as to the cost of water-purification plants. We had occasion recently to examine the cost of a large number of plants, some 34, built since the war. They ranged in cost from $16,000 to $50,000 per million gallons capacity. That is for filtration alone, and does not include the pumping station. That seems to be very widespread, but I think that a certain amount of spread is justified for a number of reasons. Some of these filter plants are being built with different water storage basins. That would naturally make a considerable spread in the cost. They are also being built with different sizes of sedimentation basins and filters. Smaller plants will cost more per million gallons than larger plants.

There is a tendency to make plants somewhat more costly than formerly, and I think that it is justified, because they have better arrangements and better means of operation.

Improvement of Operating Personnel

Another great advance in filtration practice is the improvement in the operating personnel. We are now getting well-trained technical men, and the larger plants are better looked after than they were 12 or 15 years ago. There has been a discussion as to licensing operators. I do not think that the time has yet arrived for licensing operators, because they might protect themselves behind that license in a way that is not altogether desirable. But I would be in favor of giving an operator a certificate of proficiency after he has shown that he really knows how to operate a filter plant.

In closing, I just want to remark that the increasing tendency is to house filter plants in well-designed buildings. Both from the architectural and the esthetic point of view, some of them are actually great monuments to pure water. I do not wish to be in a position of advocating extravagant construction, but I think that there are certain practical aspects about the housing of filter plants in fine buildings. Not many years ago it was the custom to put them in any kind of a building, even of corrugated or galvanized iron. The public appreciate these works more now than they ever did before. I think that somebody has said that art is the striving of mankind to attain to perfection. In a way that is what we water works men are doing with reference to the production of good water. Therefore I presume that on that basis we are artists. And if that is the case, it seems to me that it is quite appropriate for us to house our water-purification plants in beautiful, noble buildings, that typify and symbolize the most fundamental and important of all commodities, namely, pure water.

Road Building in Denmark

The Danish bureau of road classification has published a report showing that Denmark has 4,720 miles of roads, of which 4,713 miles are rural roads and 7 miles are county roads passing through villages and towns. Ordinary macadam is the preferred type of paving, 3,043 miles being paved with this material. Surface-treated macadam paves 693 miles, emulsion macadam 1 mile, and asphalt macadam a little more than half a mile. Screened or unscreened gravel is used on 756 miles, including 130 miles in Aalborg, where the surfacing is partly gravel on old flint macadam, and 65 miles partly flint, in Randers; about a quarter mile of this surfacing in Ribe is tarred, and a little more than 8 miles of the 50 listed as gravel in Tonder is earth. English paving (small stone blocks laid in curved lines rather than at right angles) is used in 168 miles of roads, and ordinary paving on 8 miles. There are 29 miles of asphalt concrete and 1.6 miles of cement concrete.

Sodium Silicate Used on French Roads

The use of sodium silicate as a hardener for the surface of roads has now been tried in a sufficient number of places and under conditions so widely varying in France that general conclusions are being drawn as to its utility. Since the first experiments in Switzerland in 1918, at least 15 French departments have experimented with roads treated with sodium silicate. One of the longest is in Beauce, where about 40 kilometers of road are involved.

A TENTATIVE STANDARD METHOD FOR GRADING FOUNDRY SANDS

THERE has been a growing sentiment among sand producers and foundrymen that a uniform method of grading foundry sands would be of advantage to all concerned. While nearly every producer has for years graded his sands in one manner or another, the systems employed have differed so widely that there has been confusion when discussing grades of sands with different producers. With a view to remedying this difficulty and providing a standard system of grading sands, the Executive Committee of the Joint Committee on Molding Sand Research of the American Foundrymen's Association, late in 1924, created a Sub-Committee on Grading composed of representatives from the foundrymen and sand producer groups. This sub-committee considered the various systems in use, compiled and examined a great mass of data on sands under production, and, after two years of work and numerous committee meetings, presented a report at the 1926 Detroit meeting of the American Foundrymen's Association in which it recommended practical methods for grading or classifying foundry sands as regards their fineness and clay contents. These methods were approved by the Executive Committee of the Joint Moulding Sand Research Committee and in December, 1926, were approved as tentative standards by the Board of Directors of the American Foundrymen's Association.

It is hoped that these methods of grading or classifying sands will be employed by foundrymen, sand producers and others throughout the country. It is recommended that foundrymen grade the sands they are using according to the system outlined and that the American Foundrymen's Association grade numbers be used wherever practical; also that sand producers and sales organizations grade their products according to the same system and offer them under their American Foundrymen's Association grade numbers. Inasmuch as the present classification covers grain fineness and clay content only, further descriptive terms should be added, such as producers' name, locality in which produced, trade name and other characteristics. A graphic representation of the screen analysis is highly valuable in visualizing the grain distribution.

Fineness Test

(Revised May 1, 1924, and Adopted as Standard by the American Foundrymen's Association, December, 1926.)

Procedure for Molding Sands Containing No Clay or Bonding Substance

1. 100 grams of sand dried for at least 1 hour at a temperature which shall not be lower than 105 degrees Cent. nor higher than 110 degrees Cent. are transferred to the first of a series of sieves, U. S. Bureau of Standards, Nos. 6, 12, 20, 40, 70, 100, 140, 200 and 270, and placed in a Ro-tap testing-sieve shaker, or other machine, the use of which may yield identical results. This machine is run for 30 minutes, and the amount of sand remaining on each sieve is weighed and expressed in percentage. The portion passing the No. 270 sieve is known as No. 270 minus.

2. 50 grams (since a 100-gram sample involves so many siphonings as to make the test prolonged, a 50-gram sample is more convenient to use) of molding sand, dried for at least 1 hour at a temperature which shall not be lower than 105 degrees Cent. nor higher than 110 degrees Cent. are put into a 1-quart preserving jar, smooth on the inside with no sharp shoulders in the neck, to permit the sand to be easily removed with a small stream of water. 475 cubic centimeters of water and 25 cubic centimeters of a standard solution of sodium hydroxide (made by dissolving 10 grams of sodium hydroxide in 1,000 cubic centimeters of water) are added, and the bottle or jar is covered and securely sealed. In using a preserving jar, instead of the usual rubber ring, a rubber disc is employed, which fits into the side of the glass cover. The receptacle is then placed in a shaking machine, making about 60 revolutions per minute, in such a manner as to allow it to be up-ended at each revolution. At the end of 1 hour the receptacle is removed, the cover is unsealed, and the sand adhering to the cover is washed into the receptacle. The receptacle is then filled with water, permitting the stream to stir up the contents, and allowed to stand for 10 minutes, when by means of a siphon extending to within 2.5 centimeters (approximately 1 inch) of the bottom of the receptacle, the water is siphoned off. More water is added, filling the receptacle, and at the end of 10 minutes is siphoned off. Water is added again, and at the end of 5 minutes siphoned off. The process of 5 minutes standing and siphoning is repeated until the water remains clear at the end of the 5-minute period. By this means the clay substance is separated from the grain, and may be collected in suitable containers and recovered by the addition of acid to neutralize the sodium hydroxide. (For practically all known American molding sands this treatment is satisfactory. There

Uniform Grading of Foundry Sands

Tentative Standard Grading Classifications for Foundry Sands

American Foundrymen's Association

Joint Committee on Molding Sand Research

Grain Fineness Number

Definition

The grain fineness number of a sand is approximately the number of mesh per inch of that screen which would just pass the sample of sand if its grains were averaged in size. It is approximately proportional to the surface area per unit weight of a sand, exclusive of clay.

Method of Determination

Make the standard A. F. A. fineness test by removing the clay and screening the grain. Multiply the weights of percentages of sand on the various screens by the appropriate factors listed below. Add the products. Divide by the sum of the weights or percentages. The dividend is the A. F. A. grain fineness number. Below are listed the multipliers for the corresponding mesh numbers.

Multipliers

Multiply per cent remaining on No. 6 mesh by	3
Multiply per cent remaining on No. 12 mesh by	5
Multiply per cent remaining on No. 20 mesh by	10
Multiply per cent remaining on No. 40 mesh by	20
Multiply per cent remaining on No. 70 mesh by	40
Multiply per cent remaining on No. 100 mesh by	70
Multiply per cent remaining on No. 140 mesh by	100
Multiply per cent remaining on No. 200 mesh by	140
Multiply per cent remaining on No. 270 mesh by	200
Multiply per cent remaining on Pan by	300

Grain Fineness Classification

Grain Class	Grain Fineness Zone
No. 1	200 to 300
No. 2	140 to but not including 200
No. 3	100 to but not including 140
No. 4	70 to but not including 100
No. 5	50 to but not including 70
No. 6	40 to but not including 50
No. 7	30 to but not including 40
No. 8	20 to but not including 30
No. 9	15 to but not including 20
No. 10	10 to but not including 15

A sand is in that grain class in which its grain fineness number falls according to the above grain fineness zones.

Clay Content Classification

Clay Class	Clay Content Zone
A	0.0% to but not including 0.5%
B	0.5% to but not including 2.0%
C	2.0% to but not including 5.0%
D	5.0% to but not including 10.0%
E	10.0% to but not including 15.0%
F	15.0% to but not including 20.0%
G	20.0% to but not including 30.0%
H	30.0% to but not including 45.0%
I	45.0% to but not including 60.0%
J	60.0% to but not including 100.0%

A sand is in that clay content class in which its percentage of clay substance falls according to the above clay content zones.

Example Showing Calculations to Obtain the Grain Fineness Number, Grain Fineness Classification and Clay Content Classification

The fineness test data of Millville, N. J., coarse molding gravel as reported in the Transactions of the American Foundrymen's Association, Vol. 32, Part II, page 338, Lab. No. 501, is as given below:

8.10 per cent clay substance
0.64 per cent sand grains caught on No. 6 screen
28.78 per cent sand grains caught on No. 12 screen
20.98 per cent sand grains caught on No. 20 screen
16.16 per cent sand grains caught on No. 40 screen
20.38 per cent sand grains caught on No. 70 screen
3.06 per cent sand grains caught on No. 100 screen
0.60 per cent sand grains caught on No. 140 screen
0.20 per cent sand grains caught on No. 200 screen
0.28 per cent sand grains caught on No. 270 screen
0.60 per cent sand grains caught on Pan

The calculation made by following the directions for obtaining the grain fineness number are as shown below:

Mesh No.	Per Cent Sand Remaining on Screen	×	Multiplier	=	Product
On 6	.64	×	3	=	1.92
On 12	28.78	×	5	=	143.90
On 20	20.98	×	10	=	209.80
On 40	16.16	×	20	=	323.20
On 70	20.38	×	40	=	815.20
On 100	3.06	×	70	=	214.20
On 140	0.60	×	100	=	60.00
On 200	0.20	×	140	=	28.00
On 270	0.28	×	200	=	56.00
On Pan	0.60	×	300	=	180.00
	91.68 = Total Sum				2,032.22 = Total Product

The total product of 2,032.22 divided by the total sum of per cents remaining on each mesh which is 91.68 gives 22 or the grain fineness number.

$$\frac{2{,}032.22}{91.68} = 22 \text{ or Grain Fineness Number}$$

With the Grain Fineness Number known, then by looking up the Grain Fineness Classification it is noted that a sand with a Grain Fineness Number from 20 up to 30 is in the No. 8 Grain Class. The sample having 8.10 per cent clay would fall in Class D Clay Content Classification.

Therefore, so far as the two classifications are concerned, namely, Grain Fineness and Clay Content, the sample would be described as a No. 8-D Sand. Inasmuch as this description covers only grain fineness and clay content, the sand should be given more complete designation—as for instance No. 8-D Millville, N. J., Sand.

are some foreign sands that are alkaline, and require an acid treatment, in which case tannic acid may be used.)

3. The grain remaining in the bottle or jar is washed on to a filter-paper, in a 9-centimeter Buchner's funnel, is drained by means of suction, then wet with alcohol, and transferred, together with the filter-paper, to a large glass, and dried for ½ hour at a temperature which shall not be lower than 105 degrees Cent. nor higher than 110 degrees Cent. The dried grain is weighed (the filter-paper may be disposed of, after drying, by burning, as it lies on top of the sand sample), and the difference between its weight ad that of the original 50-gram sample is ascertained to determine the clay substance.

4. The grain is then placed on the first of a series of sieves, U. S. Bureau of Standards Nos. 6, 12, 20, 40, 70, 100, 140, 200 and 270. These sieves are placed on a Ro-tap testing-sieve shaker, or other machine the use of which may yield identical results. This machine is run for 15 minutes, and the amount remaining on each sieve is weighed and expressed in percentage. The portion passing the No. 270 sieve is known as No. 270 minus.

5. Series of Sieves, U. S. Bureau of Standards:

Sieve Number	Sieve Opening Millimeters	Sieve Opening Inches	Wire Diameter Millimeters	Wire Diameter Inches	Tolerance in Average Opening	Tolerance in Wire Diameter	Tolerance in Maximum Opening
6	3.36	.132	1.02	.040	±3%	—15 to +30%	10%
12	1.68	.0661	.69	.0272	±3%	—15 to +30%	10%
20	.84	.0331	.42	.0165	±5%	—15 to +30%	25%
40	.42	.0165	.25	.0098	±5%	—15 to +30%	25%
70	.210	.0083	.140	.0055	±6%	—15 to +35%	40%
100	.149	.0059	.102	.0040	±6%	—15 to +35%	40%
140	.105	.0041	.074	.0029	±8%	—15 to +35%	60%
200	.074	.0029	.053	.0021	±8%	—15 to +35%	60%
270	.053	.0021	.041	.0016	±8%	—15 to +35%	90%

The Bureau of Standards notified the Joint Committee in April, 1924, of its revisions in standard specifications for sieves. The principal revisions permit considerably larger tolerances for wire diameter than had previously been called for. More latitude has been given in the revisions, for tolerances in average opening, than were previously prescribed. The revisions are accepted by the Joint Committee on Molding Sand Research, and are incorporated in the above table, which therefore does not correspond with the table in the description of the fineness test as previously published by the Joint Committee. It is most essential that the requirements of the U. S. Bureau of Standards as to size of opening be met, in the use of sieves for testing molding sand.

6. The fineness test may be graphically expressed by plotting sieve numbers as abscissa against the grain remaining on each sieve, calculated as per cent of 50 grams.

Mines in Alaska produced $17,657,800 worth of minerals in 1926, as against $18,220,692, in 1925, according to an announcement made by the Interior Department.

An Interesting Thrift Incentive

Very often the psychological moment to present industrial thrift and savings suggestions is at the time the workers are receiving their wages. The insertion of printed thrift messages into pay envelopes is an idea of this kind.

An interesting plan has been adopted by one company to encourage the saving of "extra money" which the employees receive on a monthly basis. In this plant most of the workers are on a production bonus schedule, and receive their additional participation for a given month in a separate envelope at the first wage payment period of the succeeding month. At this time the workers are handled two envelopes,—one containing the current weekly wages, the other the bonus savings, or rather earnings, for the preceeding month.

A short distance from the pay-master's window in this plant is a second window where the management places a bookkeeper who takes the bonus earnings from all workers who so desire it, and banks the money for them. The transaction is short and simple, and it has been found that more than 75 per cent of the men turn from the pay window to the "bank" window and deposit their bonus money to their account in a local bank.

In addition, however, the company has provided an incentive for them to make the desired turn. If an employee banks his bonus through the company, he receives in addition to his regular interest bilizing influence of thrift will then be made a credits of 3 per cent, an extra 3 per cent from the company,—provided, of course, he has banked through the company, regularly and without interruption throughout the entire twelve months. Thus systematic thrift is demanded of each worker, and it has been found that men who rarely kept a bank account previously are, under the incentive of the additional 3 per cent (which gives them a total of 6 per cent on their deposits) now are in possession of very healthy balances.

Like all ideas this plan is not automatic in operation. Constant attention to the development of thrift wages is needed, and the wise utilization of the funds saved requires equal consideration by the management. If workers are taught to invest their savings in constructive channels such as home buying, partial payment bond buying, etc., the stareality and the company will profit through the development of a more appreciative and stable personnel.

NEEDS AND FUTURE OF LIME IN THE CHEMICAL INDUSTRY

By James R. Withrow
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THE chemical industry will never cease to need low-priced alkaline materials. In every industry the tendency is not only for the finished product to reduce in price comparatively, but for the raw materials to increase in price comparatively, if not absolutely—in other words, toward a smaller margin between raw material costs and selling price of product. The remedy sought is usually increased production. In the chemical industry, however, another method is ardently investigated—namely, the securing of better or lower priced alternative raw materials. Here lime will always have a future, provided those responsible for its production will be continually on the lookout for the market changes.

The need is not for any kind of lime. The need in the chemical industry is for the particular lime that will suit the particular chemistry or chemical engineering involved. This particular requirement will vary from process to process and from industry to industry, if not from plant to plant. Keenness in selecting the proper lime will result in great saving of process time. For instance, a slow settling lime is exactly what is wanted for some chemical operations; otherwise, much time is lost through irregularity of dosage or administration of the lime suspension. On the other hand, a slow settling lime would be disastrous to some chemical processes because it would unduly prolong the time of the operation. In this case the selection of a quick settling lime might more than double the capacity of a given chemical plant.

The purpose of this symposium was to educate two groups. It was the intention to educate all chemical workers to the great availability of lime as a manufacturing resource, and to introduce these chemical workers, by way of education to the needs of the lime industry, to the problems and to the kinds of solutions which will be of advantage to it as well as to the market. It was also the purpose of this symposium to educate the lime manufacturers to the great opportunity of the chemical manufacturing field and to all those uses in the arts to which lime can minister so that these manufacturers may give the special attention necessary to make their particular lime render the maximum service.

We have had presented to us the value of the proper study of lime in the improvement of many important chemical industries and we have been given an insight into the lime problems of these industries and the importance of the proper selection of lime to get the desired results. The practical results of research development and engineering in the lime industry have also been discussed.

The outstanding attraction in the future of the lime industry lies in the fact that, in common with all chemical industries, the most unexpected developments in manufacture may arise from the application of thought and work to the problems of both producer and consumer.

The success of lime in the enormously important creamery problem to prevent spoiling by removing acidity is an illustration of what might be called the entirely unexpected from a business point of view. Professor Overman's work points the way to other possibilities. The paper by Mr. Hoover shows the enormous potentiality in the future of lime in the control of our water supply. Not only is the necessity for the application of chlorine greatly reduced, for Hoover and other workers have shown that lime can also render a water bacterially safe. The new developments in the prevention of after-precipitation in distribution systems will cause a renaissance in water-softening throughout the country. There are without doubt objections and problems in the new procedure, but one long step forward has been taken in the use of lime for these purposes and the cost of water-softening plants has been enormously reduced.

The future of the lime industry is assured as a basic chemical industry and will partake of the prosperity and success which is bound to attach to the future of the chemical industry as a whole. No one questions the importance of engineering. Engineering and chemistry are the backbone of engineering development. No one doubts that man is only at the beginning of industrial development. The problem confronting him in this connection is, not how fast we can grow industrially, but how well we can utilize human effort, prevent waste, and avoid missing important ideas which will reduce difficulties in production and consumption and save otherwise useless effort. The only answer to this problem is constant and continual education, education not merely of technical men, for to that we have been long committed and to that the American Chemical Society has for decades contributed. Education in chemical and engineering affairs must go further; it must be expanded into

*From a paper read before the Lime Symposium at Richmond, Va., April 14, 1927.

all fields. The great effort at education of the public which the Society has been making, especially since the Great War, must be continued. Not until the banker and the business man more universally acquire the familiarity with these subjects that is possessed by the business leaders of the lime industry will we be able to approximate a solution of our problems. The major portion of the chemical industry is thoroughly awake to this need and the lime industry must not lag behind in this great struggle.

What may be the penalty if the lime industry fails to grasp its heritage in this particular? Anyone familiar with industrial chemical development can answer this question. The more expensive product will take the place of lime, because the producers will make it so valuable to the consuming public that lime will not even be thought of. Such thorough mastery of chemical phenomena exists today, in spite of obvious gaps in our knowledge, that he is a bold man who would assume that any product has a monopoly of properties.

When we put a chemical substance into production to meet the demands of a market, variable factors crowd down upon us from every direction. They come from business, from the market, from economics, from chemical phenomena, from engineering, and from human psychology. Rash, indeed, is the business man in the face of this situation, who fails to keep actively in touch himself and to maintain a staff, however small, of extra minds who are living with every one of these problems. There is no need for an educator to talk about encouraging research. Research is being so encouraged in every industry today that for two or three years the writer has been unable to meet the demand for men for both chemical engineering and chemical positions at the rate of two to four a week throughout the year.

The lime industry has had brilliant examples of real vision on the part of some of its business leaders. These men have struggled hard to get the lime producers to see the light, but lack of men to do the work and lack of time on the part of those of us who are working on lime problems and, above all, lack of vision on the part of those in the lime industry who are not yet awake to its great future has made development less rapid in this part of the chemical industry than in most others.

This future cannot be grasped without work, without study of the consumers' problems, and without rendering the best service of which lime is capable. This demands knowledge, and still more knowledge, of lime, its properties, and methods of manufacture. The lime industry must be made a real chemical industry. To develop this basic industry into its full possibilities for service to industry and mankind requires the co-operation of the expert quarryman or mining engineer, the chemical engineer and production management, the chemical control man, and the sales and business management. The chemical industry constitutes an important and high-class portion of the market demand for lime.

The fact that lime is derived from abundant raw material insures its position as the lowest cost alkaline material at the disposal of chemical needs. Its future is only a question of rate of growth. We are only entering the consciousness of the value of chemical phenomena in the work of the world. As man's need for power and mastery of phenomena and production grows, we will more and more utilize chemical means and methods. This means greatly expanded demand for certain fundamental chemicals, mainly acid and alkaline in their nature. As an alkaline material, therefore, the future of lime is assured, but the lime producer will have much competition. He must fight for his future. Only those manufacturers with the backbone to use chemistry and engineering as weapons will win.

Too many lime manufacturers act as though they believe that the chemical industry is the dumping ground for any old lime they happen to have or be able to produce cheaply. They act as though they thought no care or attention at all is necessary in manufacture. They act as though they do not know that the chemical industry needs and deserves the cream of the lime production. Only those lime manufacturers who learn this will be able to get the advantages which come from a consistent demand for the cream of the lime production. Such service is entitled to the cream of the returns also.

Air Mileage Increasing

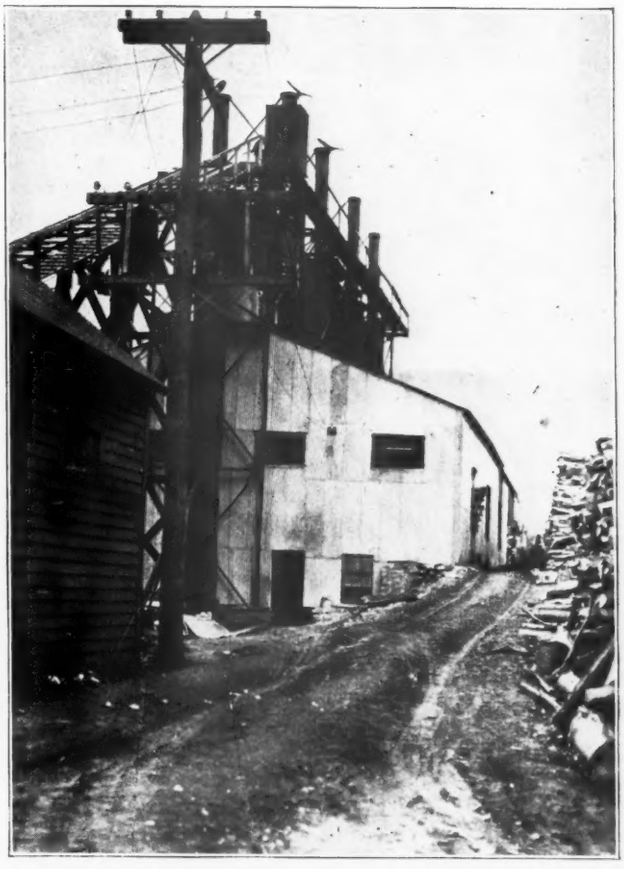
During 1926 American aircraft, including civil and military, recorded a mileage of nearly 50,000,000 miles, nearly half of which may be accredited civil and commercial planes according to an announcement made recently by Assistant Secretary of Commerce William J. MacCracken, Jr. The scheduled mileage for the year was about 4,500,000 miles, maintained in 194 airplanes over 18 regular airways and carrying pay freight amounting to 418,986 pounds.

Civil and commercial aircraft flew more than 23,000,000 miles during 1926. It is estimated that a total of 37,500 miles were flown by lighter-than-air craft during the year. Reports from scheduled air transport operators and operators engaged in sightseeing, exhibition, advertising, photography, crop dusting and other branches of ærial work indicate that approximately 23,310,355 miles were traveled by flight of 1,536 plants during the past year, using an average speed of 80 miles per hour as a basis of comparison. If the army, navy and coast guard flying time were added, the total American air mileage for heavier-than-air craft would be 48,586,492 miles.

HOOSAC VALLEY LIME COMPANY DISCOVERS ONE IMPROVEMENT LEADS TO ANOTHER

ALTHOUGH the Hoosac Valley Lime Company has an up-to-date plant, consisting of four vertical kilns, it is now in the process of making an important addition. This consists principally of two rotary kilns, 150 feet long and 8 feet in diameter. Several other changes and additions are necessitated as a consequence of this improvement. The cooperage shop is to be housed in more commodious quarters in order to produce the larger number of barrels which will be required, and crushing equipment, together with rock storage bins, is to be installed at the quarry. Certain changes are also to be made at the quarry which will be described in this article. All of the engineering work of this job is in charge of the Traylor Engineering Company and it is expected that it will be completed in the autumn of the present year.

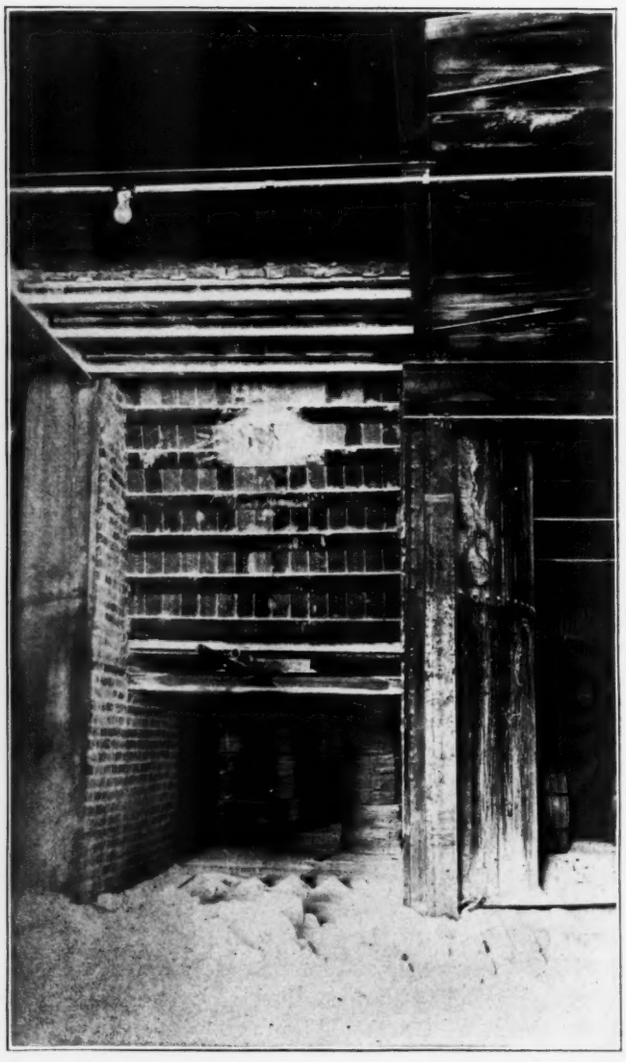
The present plant comprises four wood burning kilns. These are of a design which permits drawing every 6 hours. Each is capable of a maximum production of 200 barrels per day and the material is of a quality suitable for ground finishing lime, which is shipped in barrels. The lime when it has been drawn from the kilns and cooled is taken to a K & B pulverizer after being weighed on an S. S. & S. scale. The lime is then elevated by a Link-Belt elevator, 60 feet high, and discharged into either of two steel storage bins, each having a 500



Incline to Tops of Kilns. Note Wood Piles at Right

Partial View of Hoosac Quarry

Automatic Weighing Machine for Loading Barrels



Drawing Floor and Bottom of Kiln

Outdoor Chutes from Top of Elevator Handling Ground Lime to Storage Tanks

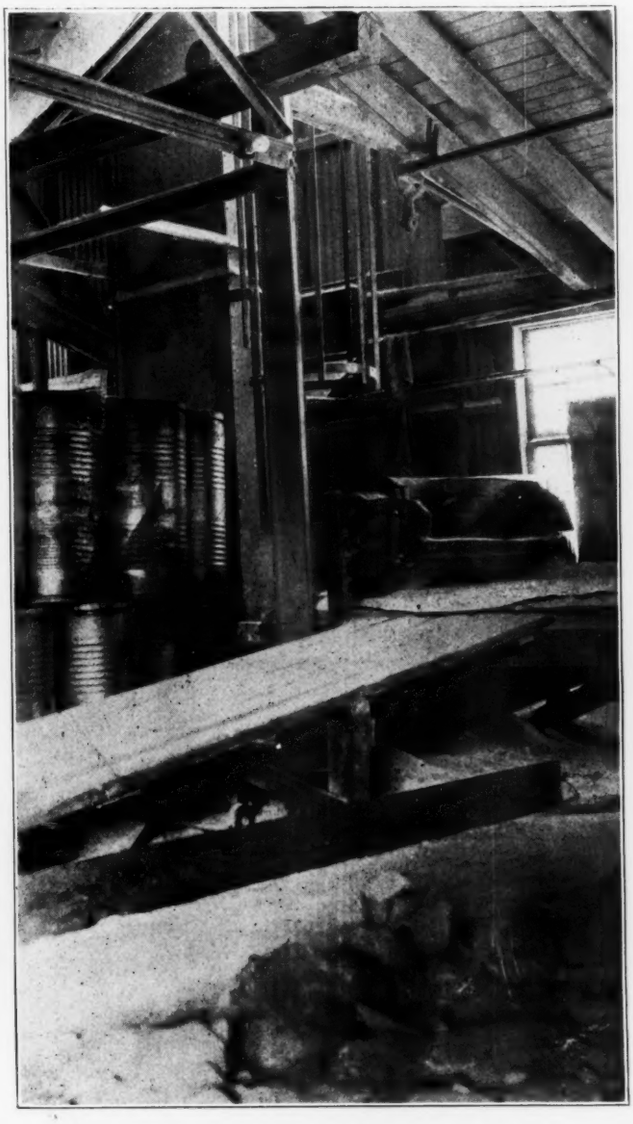
barrel capacity. Barreling is done with the help of a Howe automatic scale on casters so that it may be moved under the spout from either bin. Wood barrels, obtained from the International Cooperage Company, and steel barrels made on the premises are used to hold the lime. A railroad siding is directly alongside the building and the barrels are rolled into freight cars as they are filled and then headed up in the cars.

The material used for making the finishing lime is, of course, carefully picked over. The rejections, together with other waste and the ashes, are removed to a building at the end of the kiln house where another K & B grinder and Link-Belt elevator have been installed, this equipment being used in the production of agricultural lime. Instead of using storage tanks the ground lime is stored in a separate, metal-sheathed room where it is shoveled into either 50 pound paper or 100 pound cloth bags. This bagging room is also adjacent to the railroad siding. The motors used for the grinders and elevators are General Electric manufacture.

The kilns are charged with the lime stone by hauling cars up an incline with an electric hoist. When the cars reach the level of the tops of the kilns they are drawn along to the desired kiln by a small hoist pulling against a counter weight. The counter weight also brings the empty car back to the top of the incline. American Steel & Wire Company wire rope is used and the hoists were built by the lime company.

A cooperage shop where steel barrels are made is a part of this plant, and the machines used in making the barrels were built by Peck, Stowe & Wilcox. The metal for making them comes in sheets of the proper size and one machine crimps the edges to hold the cylindrical shape and another machine then rolls in the corrugations. With this equipment one man can make 135 barrels and heads for one end in a day.

The quarry is also interesting, being located on a mountain side, at some distance from the plant, which is situated in the valley. At the present time the face of the quarry is 95 feet high. It is an open



Incline to Grinder with Elevator at Left

Entrance to Tunnel

cut into the side of the mountain and no hoisting is necessary. The floor of the quarry has recently been lowered 35 feet more. However, before this decision was reached, a series of test borings were made with a Sullivan diamond drill to determine the character of the stone, which was found to be of good quality. Stone is moved from the quarry to the kilns in trucks. A horizontal tunnel is now being made from a level, 35 feet below the present floor, to a point under the breast. Drilling will then be carried down to the tunnel through which the rock will be taken, thus avoiding hoisting. Eventually the tunnel will disappear as the quarrying progresses. Koppel side dump cars are used to take the stone out of the tunnel as it is being made.

Drilling is now being done with three Ingersoll-Rand jack hammers and Atlas 30 and 40 per cent dynamite is used for blasting. A 10 by 12 Ingersoll-Rand compressor is being installed to replace one of a smaller size and a Koehring Dandie portable gasoline engine driven concrete mixer is being used in making the foundations. An Ingersoll-Rand drill sharpener and a number of Wallingford stone forks are located in a small house near the quarry.

Grinder and Elevator for Agricultural Lime

Simultaneous Production of Aluminous Cement and Gases Containing Phosphorus

Materials containing alumina are fused in an electric furnace with crude calcium phosphate with sufficient coke to reduce the phosphates completely. For example, when a raw phosphate of the following composition is used, CaO=46 per cent, Al_2O_3 = 2.5 per cent, Fe_2O_3 = 1.5 per cent, SiO_2 =7 per cent, CO_2 = 3.5 per cent; P_2O_5 = 34.5 per cent and undetermined and moisture = 5 per cent, together with a bauxite containing Al_2O_3 = 65 per cent, SiO_2 = 10.0 per cent, Fe_2O_3 = 10 per cent, H_2O = 0.5 per cent. A fused cement is obtained, with the use of one ton of phosphate and 0.7 ton of bauxite, if the residue from the ash of the coke is not considered, of the following composition: CaO = 42.5 per cent, Al_2O_3, 44.5 per cent, SiO_2, 13.0 per cent. Coke low in ash gives only an unimportant correction of the composition.

View Showing Breast of Quarry

SAFETY ORGANIZATION FOR THE QUARRYING INDUSTRY

CO-OPERATION between the Quarry Section of the National Safety Council and the Safety Committee of the National Crushed Stone Association has resulted in the preparation of a summary of the essentials of organizing for accident prevention. Through the courtesy of the National Safety Council, Pit and Quarry is privileged to publish this summary in full.—Editor.

1. For the quarry or mill just starting to organize for accident prevention this article will serve as an activities chart. It outlines briefly in chronological order the ten important steps that must be taken to insure success in safety work, as learned from the twelve years' experience of the 4,300 members of the National Safety Council.

These steps are:

a. Co-operation of manager
b. Co-operation of superintendent
c. Appointment of safety engineer
d. Meeting of operating executives
e. Analysis of accident records
f. Plant inspection
g. Mechanical safeguarding
h. General announcement
i. Educational program
j. Engineering revision.

For the industry that has already started safety work, this article will serve as a check list to help secure an effective and well-rounded program of accident prevention activities.

The Manager

2. An efficient safety organization starts at the top. First, the manager must do his part, and his part is to "put safety on the map," make it a necessary part of the process of production, get back of it and keep back of it so actively that every foreman and workman will know just what the company proposes to do to help make the plant safe. A safety organization without an enthusiastic manager back of it is a failure.

3. The manager must convince his men by visible signs, in the form of mechanical guards, good lighting, etc., that he is doing his full part, before he can expect his men to take safety seriously or give any genuine co-operation. It is especially important that the manager bring his superintendents and foremen to believe in safety just as they believe in production, and to give it their wholehearted and intelligent co-operation. This can be brought about by exacting from the organization exactly the same degree of attention to safety as is required in the case of production, by frequent conferences, and by placing before the foremen the experiences of other companies which have done successful accident prevention work.

The Superintendent

4. What applies to the manager applies equally well to the superintendent; he must be the field marshal in the safety campaign, and by his own faith and enthusiasm must win for it the respect and support of his foremen. If he treats it as a side issue, his foremen will treat it likewise. It must be made a vital part of the operating department.

5. The superintendent should keep in close touch with the safety engineer and acquaint himself with every important feature of the safety campaign so that he will be able intelligently to discuss and direct the work.

Safety Engineers

6. One man must be made responsible for the safety work in every quarry, regardless of its size. His duties and qualifications will determine whether he should be called the safety engineer, safety director, safety inspector, or by some other equally significant title. (For the sake of uniformity, he is referred to in this article as the safety engineer.) In small plants he need not devote his entire time to accident prevention (some advocate one hour for every 20 men), but under no circumstances should this responsibility be given as a side-line to an already overworked individual.

7. In addition to a knowledge of safety, the successful safety engineer must have nearly every personal qualification that is to be found in successful men in all walks of life. He should have vision, initiative, persistency, judgment, diplomacy, leadership, and, above all, sympathy and a desire to serve. To be worthy of the title "Engineer" he should have had a technical training or its equivalent in actual experience. Just as no one is perfect in any walk of life, so there are successful safety engineers who do not have all of the personal qualifications listed; others may have most of the personal qualifications but not a technical training. In safety engineering as in every other branch of work, special training may be necessary in highly specialized industries. However, the safety engineer can generally secure from others such special information as he requires.

8. An important feature of accident prevention work is that the safety engineer should know the men he is working for and with, for much of his success will depend on the manner of his contact. Some men must be driven and others may be led; if the safety engineer is to get results he must use

both methods, adapting them, however, to the types of men involved in the work. The accident prevention work which is most constructive and most lasting is often accomplished by getting other men to do it. Sometimes this is brought about by suggestion; perhaps, by direct request or as a personal favor, and again by an order from the superintendent. Whatever the means, the result will be that the man who does the work is interested to a greater degree than he would be otherwise and he feels a personal responsibility for his share of the work. If handled tactfully, this principle will work with the plant engineering department and the plant executives, as well as the workers.

9. The safety engineer's actual position in the quarry organization varies with the general organization of the individual plant. In some quarries the safety engineer will have charge of practically all employee relations, including employment, safety, sanitation, health, service, general welfare work, employees' activities, etc. In any event, the safety engineer should be in close touch with the department handling the employees' relations throughout, so that his work may be definitely coupled with the other branches of the work of that department. It is now generally accepted that practically every phase of an employee's life has a bearing on accident prevention and it is for this reason (if the safety engineer has no direct control over the company's relations with its employees) he should be connected with the department handling such relations. The educational side of accident prevention is very definitely an employees' relation. His duties may include:

a. To represent the management when the chief operating executive (vice-president or general manager) cannot attend to certain duties in safety.

b. Supervise safety bulletin board service.

c. Arrange meetings.

d. Investigate all accidents and near accidents.

e. Keep accident records, make analyses of accidents, and prepare special reports.

f. Help to convince the workmen that the management is sincere in its efforts to prevent accidents.

g. Confer with the superintendent, foremen and workmen; assist them in designing guards and in eliminating unsafe practices.

h. Keep a record of all recommendations and their final disposition.

i. Acknowledge and record all suggestions by workmen.

j. Attend safety conferences and the National Safety Congresses; visit other plants and other safety engineers; use the Council's information bureau and library service; in this way gather ideas and information with which interest in accident prevention can be stimulated and general plant conditions improved.

k. Serve as secretary at all safety committee meetings.

l. Assist the employment department and advise in instructing new men in safety rules and general shop practices.

m. Make regular inspections of the plant, including cranes, elevators, chains, etc., and keep written records of all such inspections.

n. Make inspections for fire conditions and equipment.

o. Organize and maintain fire drills and fire brigades.

p. Check all plans and specifications for all new equipment for safety before it is purchased and installed.

Additional duties will be suggested by other items outlined in this article.

Analysis of Accident Records

10. Let us sketch briefly the duties of a safety engineer in a medium-sized plant in which no safety work has been attempted other than safeguarding required by an insurance company or the state factory inspector. In accepting the position the safety engineer has satisfied himself that the management is sincere in its desire to prevent accidents and that it proposes to follow every reasonable and practicable plan for securing the cooperation of its employees in safety work. The first step taken by the safety engineer is to analyze the company's accident reports for the past two or more years. He should tabulate all accidents by causes and departments, and calculate accident frequency and severity rates, etc. This work is necessary:

a. To determine the real causes of accidents so that proper preventive measures may be prescribed.

b. To secure concrete evidence for skeptical foremen to prove that their men are being injured.

c. To prove to foremen and workers that the majority of accidents result from carelessness or ignorance.

d. To determine if accidents are more frequent in certain divisions or departments than in others.

e. To see if there are any men whose physical conditions, as revealed by repeated accidents, make them unfit for certain operations.

f. To give the management definite information about the cost of accidents both to the company and to the workers.

g. To furnish proof that accident costs have a definite bearing on production.

h. To stimulate competition between departments for improvement of accident records.

i. To provide material for homemade safety posters.

11. While making this analysis of accident records, the safety engineer should take advantage of every opportunity to establish personal and intimate relations with the superintendent, foreman

and other plant executives. Doing this may prevent unpleasant misunderstandings later on.

Meeting of Operating Executives

12. The next step is to call a meeting of all foremen and department heads, at which the quarry manager, general superintendent or some executive of the company should preside. The things to be accomplished at this meeting include:

a. The operating executives—and particularly the foremen who are acknowledged the lieutenants of industry—should be notified of the accident prevention plan in advance of the workmen.

b. The safety engineer should be officially introduced and his duties outlined.

c. The attitude of the company toward accident prevention should be definitely outlined, emphasizing the willingness of the management to back up the operating executives—by discipline, if necessary.

d. The operating executives should be notified that they will be held responsible for accidents to men under their supervision, and impressed with the fact that the success of the safety effort depends upon their leadership and good example.

e. The benefits of safety work can be proved by giving records of other companies.

f. Each foreman should be asked to prepare a report describing conditions in his department and listing the points of danger which need safeguarding.

g. Acquaint these men with the past accident experience of the company.

h. Point out the bearing accidents have on labor turnover and production costs.

i. Emphasize the point that the dollar side of safety means more to the workmen than it does to the company, and the workers suffer all the physical pain resulting from accidents.

j. By referring to past experience, prove that approximately three-quarters of all accidents are preventable and are the result of ignorance and carelessness.

k. Have the safety engineer (and possibly one from another quarry or an insurance company) acquaint these men with the methods used and results obtained by other companies.

Plant Inspection

13. Following this meeting a complete inspection of the plant should be made by the safety engineer, accompanied in each department by the foreman. This inspection is made to:

a. Help the foreman in each department prepare his report as requested at the foremen's meeting.

b. Determine the physical condition of the plant and to check all dangers that need to be safeguarded.

c. Prepare for the guarding program.

d. Improve general housekeeping, sanitation, etc.

e. Determine "can an accident occur here," not "has an accident occurred here."

Mechanical Safeguarding

14. The safeguarding program should then be developed, making sure that the most serious conditions are corrected first. All safeguards should be installed in accordance with the specifications of the state and insurance company standards. Carrying out this program satisfactorily will not only eliminate the majority of the accident hazards, within the control of the company, but it will also impress upon the workmen the idea that the company is sincere in promoting safety and willing to do its full part.

General Announcement

15. Then, and not until then, the workmen should be acquainted with the accident prevention plan. This can be done through personal letters to the workers, through announcements posted on the bulletin boards, through the plant publication, at departmental meetings or at a general mass meeting. This is necessary to give publicity to the plan and to arouse enthusiasm for carrying it out. Without the cooperation of the workers, the plan will fail.

Educational Program

16. Now some thought should be given to the type of organization that is best fitted to the particular quarry or group.

17. The size of the quarry is usually the determining factor in deciding what committees must be organized to function in that particular quarry. There may be four different plans of safety committee organizations for the following types of quarries:

a. Small quarry: less than 150 employees.

b. Medium size quarry: 151 to 500 employees.

c. Large quarry: 501 or more employees.

d. Company operating two or more quarries.

18. Before considering the plan best fitted for the particular quarry or company, it may be well to consider the general purpose and functions of safety committees.

The general purposes are:

a. To arouse and maintain the interest of superintendents, foremen, etc., and do away with the idea that "Safety is the business of the safety department only."

b. To arouse and maintain the interest of workmen and convince them that they are largely responsible for accidents and that their co-operation is needed to prevent them.

c. To make safety activities an integral part of all operating policies and methods and in reality an operating function.

d. To provide an opportunity for the free discussion of safety problems and the advancement of ways and means for accident prevention.

e. To improve the co-operative spirit between management and employees.

f. To assist the operating manager in studying the value of safety suggestions.

19. The function of safety committees in general may be classified as:

a. Legislative—to determine safe policies and recommend their adoption to the management.

b. Executive—to get things done.

c. Educative—to teach the committee members and through them the entire personnel of the company.

20. In any industry, large or small, assuming that the management is convinced of the value of safety work, there are many decisions to be made as to the policy of the company, such as:

a. Standards for guarding machinery and equipment.

b. Standards for the design and purchase of new equipment, machinery and buildings.

c. Standard operating practices, including safety rules and systems of reward or penalty.

d. Any question of safety policy, including the decision on what to do with any specific problem that arises.

e. Accident cause classifications for statistical purposes.

f. To review all executive matters that may be referred for action or recommendation to the management.

21. The operating manager of the company or quarry may not wish to work out all the details of all such questions of policy; although, of course, he will have the power of final approval or disapproval. The safety engineer can assist materially in this work through studies and investigations and he in turn can be helped by a safety committee, composed of qualified men appointed by the management to make suggestions regarding such matters and work out details relative to their application.

22. Another big problem in each quarry is to translate into action the safety policies that have been adopted in principle—to make safety really a part of the routine plant operation. This is best accomplished through safety committees acting under the supervision of the manager. They should:

a. Act as a clearing house for all safety ideas and activities and follow them until disposed of.

b. Make, or have made, investigations of all important accidents, or conditions causing near accidents, and recommendations for the prevention of a recurrence.

c. Supervise safety contests or competitions and award prizes.

d. Assist in deciding any questions that arise in applying the safety standards, and any questions of operating methods which affect the safety of the men.

23. As with legislative matters, the operating manager may not wish to make decisions on certain executive matters without having them first considered by a group of men who would be directly affected. It is sometimes advisable, therefore, to give this authority to a committee of selected men who are properly qualified, so that mature thought will warrant the management's approval without further investigation.

24. All safety committees have an educative value for the men who are appointed to membership. Service on safety committees is the best, and sometimes the only means of arousing and holding the interest of the men in safety and thus securing from each the necessary co-operation in his own department. Such interest is absolutely essential for maximum success and can be secured only when each of these men is completely sold on the safety idea. Engineering revision (revision of manufacturing processes and rearrangement of equipment) as applied to the problem of preventing accidents will be influenced largely by the degree of interest in safety problems possessed by the construction engineer. Maintenance of equipment will be considered in its true relation to safety by the master mechanic or superintendent of maintenance only when he realizes the importance of safety in plant organization. The employment manager should realize that hiring, placing and instructing workers has a distinct bearing on accident prevention. The purchasing agent should understand the necessity of purchasing materials according to definite specifications, as furnished by the safety department, and of requiring all manufacturers to incorporate in their machines every practicable provision for the safety of the operators. Quarry superintendents must be convinced that supervision plays an important part in the elimination of accidents, that they are accountable for accidents in their departments just as they are accountable for production, and that the safety of their men is a real part of their operating problems.

25. Because of the differing degrees of emphasis on these three factors—legislative, executive and educative—as well as different kinds of plant organizations and conditions, different combinations of safety committees are found in various companies. In a company of small or moderate size, the first two, or even all three, functions may be combined in one committee. Any committee system, however, should provide for all three functions, as each is important. Experience has shown that the most productive field now open to development is that of education—reaching the individual, creating and maintaining interest.

For Small Quarry

26. In a small quarry, a single committee may combine all of the functions and activities which have been outlined above. For a quarry or mill employing less than 150 men, a typical committee might include the following men as members:

Manager.
Superintendent.
Mill Engineer.
Master Mechanic.
One or more foremen.
One or more workmen.
Safety Engineer.
Purchasing Agent.
Employment Manager.
Company Physician.

27. The committee might include all of these men, although not necessarily so; but in no case should it be composed of less than three members. The chairman of the committee should be the member who holds the position of greatest authority in the plant, and the safety engineer should serve as secretary and adviser. All members, except the chairman, often rotate in office.

28. The duties of such a committee will naturally cover the entire field of accident prevention. It will handle all legislative and executive matters as outlined in previous paragraphs, generally including fire protection and sanitation as well. In addition, it should:

a. Review and approve reports of weekly inspections by safety engineer.

b. Study all recommendations to determine their practicability.

c. Record and familiarize the committee members with the causes of all accidents for the purpose of devising preventive measures.

d. See that new employees are properly instructed by some one as to the hazards of their work, and that employees of the different departments are educated in safe practices through the use of posters (such as those published by the National Safety Council), printed rules, or oral instructions.

e. This committee should meet at least once each month, and a copy of the minutes written by the secretary (safety engineer) should be sent to the operating manager or other designated authority for review. The manager should be invited to attend meetings whenever possible. His presence will indicate his support.

For Medium Sized Quarry

29. The committee organiaztion for a medium sized quarry (151 to 500 employees) should be the same as for a small quarry with the optional addition of a single committee composed of three or more workmen. This might be called the "Workmen's Safety Committee." The committee specified in paragraphs 26 to 28 might then be called the "Quarry Safety Committee."

30. In some companies a foreman is selected by the quarry safety committee to serve on the workmen's safety committee and he automatically becomes the committee chairman. He usually serves for six months or for some other predetermined term, after which another foreman is appointed for this work. In this way, all of the foremen are rotated and given this experience. In some quarries, the foreman who serves as chairman of the workmen's safety committee is also a member of the quarry safety committee.

31. A workmen's safety committee usually consists of three or more men. The usual term of service is three to six months, depending on the size of the quarry and the plan of organization; the members being replaced one at a time. This in itself is an educational feature, to acquaint the workmen with the management's efforts in the prevention of accidents, and to impress upon all of the employees that they are a part of the safety organization. Once a man has served on the safety committee he is considered a committeeman whether active or not, due to the rotation of membership. Sometimes the aim is to have every man in the organization serve on the committee eventually.

32. Because such a committee accomplishes its purposes largely through the self-education of its members who become "sold" on safety through their investigation of accidents and their discussions on accident prevention, it is common to change all or some of the membership of the committee at regular intervals. This introduces the element of rivalry, each committee being anxious to equal or surpass the record of its predecessor.

33. The exact number of people who can work best together is yet to be determined. Probably there is no standard number. Practically, of course, the safety committee will be somewhat dependent on the quarry organization, usually giving representation to all trade groups. From the standpoint of good committee procedure, the important thing is to have enough members to insure a variety of ideas and opinions, and a small enough number to make sure that in a relatively short meeting all will have had an opportunity to express themselves.

34. As to the election or selection of members, there has been much discussion. Election has the advantage of being democratic; it helps to convince the workers that the management is sincere in its desire to have them take a real part in the safety program. But election, particularly at the outset, is likely to be an unsatisfactory method. Men are likely to be chosen for reasons quite apart from their ability to harmonize in a workmen's committee. This is especially true before the quarry, as a whole, has been educated to an understanding of the safety committee's work. If the management recognizes the qualities that are needed, appoint-

ment is apt to be the more satisfactory method. Where election has been most successful, it has been introduced after a successful experiment with appointed committees, combining the advantage of democratic election and careful discrimination.

35. The duties of the workmen's safety committee are:

a. To make regular monthly inspections for unsafe conditions and practices and submit to the safety engineer a written report of its findings, who in turn submits it to the plant safety committee.

b. To instruct and warn fellow workmen of dangerous practices.

c. To investigate all serious accidents and near accidents and submit reports and recommendations.

d. To help improve the co-operative spirit between management and employees.

e. To interpret and instruct in safety rules.

36. In addition to regular routine duties, members of these committees, when making inspections, often pick men at random, and question them on the safet yrules for their particular jobs. These data are included in the committee report, and if unfavorable, the man is given the necessary instructions, through his foreman.

37. The purpose of such committee work is partly to furnish information on accident hazards and remedies to the foremen and the safety engineer, but the principal value of these activities lies in the educative effect on the committee members themselves and thus on the general body of employees. My studying accidents and their causes at first hand, the employees on the committee are convinced of the large part played by the workman himself in causing and preventing accidents. Give a workman some active part in safety work, some recognition, some responsibility—and you will secure his interest. This has been the experience of all members of the National Safety Council who have properly organized safety committees.

38. The one indispensable thing is that the foremen shall believe in the committee idea and constantly encourage the men in their work. It is the foreman—acknowledged the lieutenant of industry—upon whom hinges the success of such committee work. Unless he is "sold" on accident prevention, the members of this committee cannot be expected to be safe workers creating the interest and co-operation desired.

39. The safety engineer should attend all safety committee meetings. He should be careful neither to dominate these meetings nor to limit the initiative of the members, but in a tactful way he can guide and direct their activities to accomplish the maximum results.

For Large Quarry

40. A large quarry employing 500 or more workers should have a quarry safety committee and one or more workmen's safety committees. Many companies organize a workmen's safety committee in each principal department, and confine their activities to their respective departments. From time to time it may be advisable to have these committees inspect departments other than their own. In this way unsafe conditions and practices are often discovered that may have been overlooked by men who see them continuously and therefore do not appreciate the dangers.

For Large Company Operating Two or More Quarries

41. Companies that operate two or more quarries should organize safety committees in each quarry in accordance with the number of workers employed as specified in preceding paragraphs. In addition to this a new committee—called the "Inter-quarry or Central Safety Committee"—should be organized. Under this enlarged organization the quarry safety committee will perform the same duties as in a single quarry, except they will make reports to the inter-quarry or central safety committee. In addition to this they will also execute the orders of the inter-quarry or central safety committee.

42. The members of inter-quarry central safety committees should be chosen because of their authority and expert knowledge, and will naturally consist, for the most part, of operating executives, such as the managers of individual quarries, including the general manager, or vice-president in charge of manufacturing, the chief engineer, the head of the employment department, quarry superintendents, the company doctor, and of course, the safety engineers. The chairman should be the general manager or vice-president in charge of manufacturing. There is no particular reason for periodic changes in the personnel of such a committee, except that such changes give all the "line" or "staff" executives a chance to take an active part in the accident prevention program.

43. A good example of committees of this type is found in the United States Steel Corporation. The corporation inter-company safety committee, organized in 1908, comprises officials of the corporation and representatives from the larger subsidiary companies, and determines the general legislative safety policies of the corporation. In each plant there is a plant safety committee caring for all executive matters. In addition there are departmental or workmen's committees at each plant. This type of safety committee organization thus covers the entire field of accident prevention. Every safety problem that arises can be cared for expeditiously and efficiently, and the solution sent to all plants and companies.

44. In the International Harvester Company the inter-plant safety committee consists of the vice-president in charge of manufacturing, the

manager of various works, the manager of manufacturing, the manager of industrial relations and the chief safety inspector. This committee supervises all safety activities and determines all legislative matters pertaining to accident prevention.

Maintaining Interest

45. There are many ways of maintaining interest among safety committeemen. To begin with, it must be ascertained that the men selected to serve on the committees have the interest of the safety work at heart. Then, to maintain that interest requires constant effort on the part of the chairman, the safety engineer, and the general safety committee or the central organization. Members of safety committees should be given something to do other than mere reporting of unsafe conditions and practices. They should be given a more active part in the work and made to feel that the success of the committee depends upon the individual support of each member, the supreme aim being to arouse interest in the work among all employees to the extent that they will realize that safety is just as important to them as the work they perform.

46. Among agencies for arousing and maintaining interest among committeemen none are more effective than supplying members with information along educational lines, such as data from outside sources, frequency of certain classes of accidents and comparative statements with other months of the year, other years, and other organizations. Pamphlets published by the National Safety Council and information gained through the columns of the National Safety News provide helpful information for committee members and may be used to advantage in promoting a safety spirit.

47. Monthly News-Letters consisting of contributions from members of safety committees, information concerning certain classes of accidents noticeable by their frequency, their causes, and methods for overcoming them, also articles taken from other magazines and plant publications that will excite interest, are often used to advantage.

48. Knowledge in every occupation is the surest basis of success. The value of educating employees in accident prevention lies in their automatically watching out for ways in which men are injured and coming to realize that more men are injured through lack of thought than through mechanical causes.

49. There are many other ways of maintaining interest among committeemen, such as well prepared posters (as published by the National Safety Council) and the attractive manner in which they are posted on bulletin boards, safety rallies, proper and prompt handling of suggestions by chairmen, rotation of members, membership cards, safety buttons and emblems, and awards for special accomplishments in connection with the safety program.

50. A committee must have leadership—someone who will be its life, make it go. This is not the problem of finding a good safety engineer. It is the problem of finding a leader amongst men. He should at least have the confidence of other committee members, be practically familiar with the safety problem, be enthusiastic about the safety program, have a pleasing personality, be understanding of other members and able to draw out discussion rather than dominate it; be somewhat familiar with committee practice and procedure.

51. Committee meetings should be held during working hours under as favorable conditions as possible. Dark, poor ventilated, over-heated rooms should be avoided. Bright, cheery and airy rooms add "pep" to the meeting when the chairman follows a regular order of business.

Engineering Revision

52. Engineering revision means the improvement or redesign of machinery, equipment, and processes, so as not merely to cover up hazards but to eliminate them and at the same time to increase efficiency and production. This engineering phase of safety is often neglected, but it can well be made a major activity that will pay unusually large returns on all of the time and effort that may be invested.

53. Safeguards are usually but temporary expedients awaiting the development of more fundamental means of eliminating accident hazards. For instance, several years ago numerous gates and guards were installed on power presses to sweep away the operator's hand when the ram descended. These safeguards have now become more or less obsolete because of the development of mechanical methods of feeding. These feeding devices make it difficult and in most cases impossible for the operator to get his hand into the danger zone.

54. One of the companies that pioneered in engineering revision as applied to power presses, has practically eliminated all power press accidents, whereas they used to cut off an average of 36 fingers a year. Not only that, but the production of these presses has been increased 60 per cent. What has been accomplished in this particular operation can and should be accomplished in many other industrial operations, and the safety engineer is often looked to for leadership in this work that is so fundamental and yet so far-reaching in its effect.

Financial Loss From Smoke Estimated

Gordon D. Rowe, chief smoke inspector of Cincinnati, Ohio, estimates our annual financial loss in the United States, from smoke and its effects, to be $1,870,000,000. This is enough money to build a 12 inch paved road, 50 feet wide from New York to Los Angeles and bisect it with another from Chicago to New Orleans, according to Mr. Rowe.

Cement Technology Activities of Famous Berlin School

The scientific work, during the past year, conducted at the Cement Technology Department of the Technical High School at Berlin related chiefly to the preparation, testing and hardening of cement. The principal effort was devoted to checking present methods and the development of new methods for the rapid determination of lime in cement and mortar. At the same time researches were conducted on the precipitation of silicic acid on membrane filters and the determination of chlorine in hydraulic cements. Of the researches in the field of cement investigation may be mentioned first the determination of the very fine particles in cement. The increasingly fine grinding of cement for which the older methods of determination no longer suffice led to a doctoral investigation by Czernin. The sedimentation apparatus of Wiegener and Guttmann-Köhler were first tested. As neither apparatus quite sufficed to meet the needs, a new process was worked out in which the sedimentation within a column of liquid was not the basis, but rather the sedimentation through a column of liquid was used as the basis for measurement.

The Technical Laboratory was extended by setting up a new model of a cementing ram. In addition a large insulated chamber was arranged with automatic internal heating. This avoids practically all influences due to temperature variations in the test pieces made in the course of a day. For the education of practical workers the utilization of a rotary kiln increased in length by about 6 feet was found to be very advantageous.

Together with these projects especial emphasis was placed on the development of technical testing of small batches on which the first report was made at Hanover in 1926. The process for the small scale manufacture and small scale testing of cement has practically raised the synthetic researches in the field of hydraulic cements to the completeness with which preparation researches are carried out in other organic and inorganic laboratories. By the introduction of small scale testing an expansion of the laboratory facilities along the lines of grinding, burning and testing apparatus was necessitated. For grinding porcelain ball mills manufactured by the State Porcelain Manufactory were used. The burning was first carried out in the Heræus tube furnace in which the raw flour forms were wrapped in platinum foil in order to protect them from contact with the refractory walls of the heating tube. It was found more convenient even if not quite so accurate to work with Silid resistance furnaces whose burning space is large enough to receive platinum crucibles. This process has the advantage that the charge can not be only sintered but even fused if desired. It thus offers the possibility at present available in no other method of conducting accurate experiments on fused cements.

In working out new methods for small scale testing the methods of strength testing were subjected to scrutiny. The determination of tensile strength on a small scale by means of the bending test on test pieces of 3 ccm. volume (about 1/5 cubic inch) was completely worked out on a technical scale. The apparatus department of the Clay Industries Laboratory has brought out a new sturdy and convenient model. In addition the testing of compression strength on a small scale has led to the design of a suitable press in which test pieces of 2 square cm. surface and 2.8 cubic cm. volume can be tested. At the present time efforts are being made to improve this apparatus further as it has hitherto been difficult to avoid a lateral shearing due to oblique clamping. Due to lack of time it has not been possible to extend the work on small scale testing to include the determination of the setting time and the constancy of volume.

The doctoral work of Ullrich represents the first investigation completed with the aid of small scale testing methods. Exact data were obtained on the influence of temperature of burning, the sintering temperature, and the rate of cooling for sintered cements, data which have not confirmed the practical data in certain respects. The reproducibility of results by small scale testing methods is remarkable. Meyer is making a similar investigation of fused cements. Klepp is continuing the work of Hurt which left a series of problems unsolved and is working by the small scale testing methods on the cements which lie between portland cement and blast furnace slags.

The theory of hardening which is not yet free from objections has been the subject of an investigation by Klasse on calcium hydrosilicate. In this work a definite calcium hydrosilicate is to be prepared and its colloid-chemical properties are then to be studied. The carrying out of this research necessitated a larger mechanical shaking device as well as an ionic conductance apparatus.

New South Wales, Australia Accepts Federal Aid

New South Wales is obtaining £5,520,000 from Commonwealth Government over a period of ten years, and contributing £4,140,000 itself for road building purposes.

The 1927 road program of the Province of Alberta includes the graveling of the main highway between Edmonton and Calgary. It is expected that this work will be completed by the middle of September. Approximately $250,000 will be spent for the construction and maintenance of local roads.

LIGHTNING SERVICE BUILDS BIG BUSINESS FOR BRANNAN SAND AND GRAVEL COMPANY

By Willis H. Parker

ADVERTISING "Lightning Service" and speaking the truth in the advertising has enabled the J. W. Brannan Sand and Gravel Company, Denver, Colorado, to build up an exceptionally large business in Denver and immediate vicinity in the past twenty-seven years since the firm adopted this merchandising practice. As a result the firm is supplying approximately 85 per cent of the sand and gravel used for commercial construction purposes in Denver.

Two factors contribute to the ability to give quick service. The first is an excellent fleet of delivery trucks and the second is the operation of several pits located at strategic positions about the outskirts of the city, thereby eliminating much of the empty back haul and making it possible to deliver sand or gravel to the customer from a pit nearest to him, rather than from the opposite side of the city, as is so often the case where but one pit is operated. Backing the delivery fleet and the several pits operated is a traffic department run upon lines similar to a train dispatching organization. In this the telephone plays an important part—in fact good telephone service is vital to the operation of the plan. Let us consider first the delivery fleet.

The Brannan company first began to operate trucks of their own about six years ago when a strike of truck drivers who were operating independent of the sand companies tied up the movement of this important building material. The demands of the truck owners were somewhat technical and were based upon an equalization of the haul—a problem unnecessary for this story. However, Mr. Brannan, president, saw then that it was absolutely necessary to have a fleet of trucks of his own so as to provide delivery service to contractors who were depending upon his company for material. Being of an observing nature he had noticed that the drivers of a certain make of truck were the ones who seemed to be making the most trips each day, therefore earning the most money, had less trouble in operating their machines and were apparently less tired at the end of the day than were the owners of other trucks who were working on a contract yardage basis. He felt that if these trucks were giving such excellent service to the men owning them, it would pay the company to purchase trucks of this make. So the first trucks were all of one make and proved so satisfactory that as the fleet was augmented the additional trucks were of the same variety.

By having trucks of the same make, maintenance costs are somewhat reduced since some of the parts are interchangeable, thus eliminating the necessity of carrying a large stock of parts. A machinist experienced in this make of trucks is able to service them at less expense than if the fleet were composed of a variety of machines.

So satisfactory did this plan work out that, when the company's fleet was not large enough to handle peak business and outside trucks were hired, the company employed truck owners who operated the same kind of truck. This assured uniformity in delivery service and maneuverability of equipment.

The servicing of the machines is rigidly maintained. They are thoroughly greased every week, and bolts, nuts and other connections tightened. Two men under the direction of a truck superintendent accomplish this work. Once a month they are completely inspected and any part needing replacement is replaced immediately. In addition to this, every driver is also a good mechanic and capable of doing some service work on his machine.

While the company does give quick service, the speed is not attained by the rapidity with which the wheels of the truck turn over. It is obtained by making haste slowly and steadily, and coupled with the dispatching system. The machines are controlled by governors to a speed of from 13 to 15 miles an hour. Only the most experienced of drivers are employed, which goes far toward elimination of delays occasioned by accidents to machinery, stalling on the road and traffic jams.

One man does nothing else but dispatch the trucks. His headquarters are at the main office, of course, but he has direct telephone connections with each pit. As fast as the orders are turned over to him, he phones them to the pits where he knows a truck will soon report after having completed a delivery. Putting it another way, the truck drivers report to the nearest pits, after completing deliveries, for the orders to be filled in that territory. This does not mean, however, that Mr. Contractor will get material delivered to him from the pit in his closest vicinity, for this is not always the case. When the trucks start out of a morning, one may start from Pit number 1, for example, with an order to be delivered in the vicinity of Pit number 2; this because no truck was at pit number 2 at that moment and it would be cheaper to haul the sand from pit number 1 than to make a trip empty to pit number 2, get the load and deliver it. However, when he completes his delivery, the driver goes to pit number 2, where he picks up any orders that may be delivered on his return

to pit number 1. Then, again, the delivery may be made in the direction of pit number 3, whereupon the driver reports to pit number 3 when he has completed his task. It is not uncommon for a truck to make the rounds of all the pits in the course of a day's work, but it can readily be seen that such a system reduces the empty haul to a very small percentage of the round trip mileage.

As an example of how this system works and what speed may be obtained, an incident is cited (this did not come from company officials either) of where a contractor called the company about 7:30 o'clock one morning, before he left his home for the job, and asked that a couple of yards of sand be delivered on the job as soon as possible. He left for the job immediately afterwards and when he arrived he found a Brannan truck unloading the sand. This was not an exceptional case, either, for many similar ones could be cited.

Of course there are variations in the program of reporting to the various pits, for there are times when the bulk of the business is coming from one section of the city or where one big job requires an enormous amount of material and several trucks must be assigned to that delivery, but those trucks will work out of the pit nearest located to the job.

In peak seasons as many as fifty big trucks are hauling sand and gravel out of the Brannan pits. Not all of them are owned by the company, but from all appearances, they are, for contract truck owners like to work for the Brannan company and under Brannan company rules because they can earn more and are assured of steadier work and for that reason they are willing to paint their trucks the Brannan colors and put the Brannan sign on the sides. They are assured of enough extra work to make it worth while to become a part of the Brannan organization. Thus the public knows no difference between a Brannan truck and driver and a contract truck owner.

The trucks, according to Mr. Brannan, are the company's representatives, when they are out, just as is any salesman or official of the company—this because of their excellent appearance and the courtesy of the drivers. The trucks are always clean and the drivers always polite. Across the rear of each truck is painted in prominent letters underneath the name of the firm these words: "Please Report Any Discourtesies."

A Brannan truck never "hogs" the right of way and one of the company's rigidly enforced rules is: "Never force your right of way. Give rather than take it. Whether right or wrong yield the right of way rather than risk an accident." The motoring public appreciates this even though it is not generally known to be a rule.

Mr. F. P. Spratlen, vice-president and treasurer of the company, declares that the enforcement of other rules and the exceptionally small number of accidents in which the company's trucks have been involved has enabled the firm to enjoy a reduction of 40 per cent in their liability insurance rates.

The other rules are:

Number 2. Carry no passengers. Not even a member of the driver's family is permitted to ride on the truck.

Number 3. Never permit children to jump or ride on the truck.

Number 4. Pass children and schools with caution and slowly.

Number 5. Avoid passing hospitals with heavy trucks either loaded or empty.

Number 6. Be courteous, always.

Last year only one accident occurred in which a Brannan company driver was at fault and in this case the damage paid by the company was only $37.50. The driver of a company truck will stop immediately if he sees an approaching motorist who apparently does not know which side of the road he is going to take, for there would be less likelihood of a serious accident if the truck was motionless and a touring car ran into it than if the truck with its heavy load were moving also.

Thus the employment of good trucks, experienced drivers and the operation of a dispatching system governing the movement of the trucks from the nine pits has enabled the firm to carry out the advertising slogan—"Lightning Service"—and build up a remarkable business.

Income Tax Figures Public

A total of 4,171,051 individuals throughout the United States filed income tax returns for 1925, the aggregate net income being $21,894,576,403 and the net tax $734,555,183 according to the latest edition of statistics of income made public by the bureau of internal revenue on June 25.

As compared with the preceding year the returns for 1925 show a decrease of 43.40 per cent in number of returns, a decrease in total net income of 14.66 per cent but an increase of 4.30 per cent or $30,289,793 in total tax collected. For 1925 the average net income was $5,249.16, the average amount of tax $17.11 and the average tax rate 3.35 per cent. For 1924 the average net income was $3,481.26, the average amount of tax $95.56 and the average tax rate 2.74 per cent.

Large Blast in Cuba

The largest blast ever set off in Cuba destroyed the Somorrostro Hill in Habana Province to obtain 100,000 cubic meters of stone for the Central Highway Project. Employees of the American company which is constructing the greater part of the highway drilled a 500 foot tunnel and placed 15 tons of explosive at a depth of 100 feet.

ROUTINE SAND CONTROL IN THE PIPE FOUNDRY

By M. Kuniansky
Chief Chemist, Lynchburg Foundry Company*

FOR the past two and a half years our laboratory has been performing routine sand control work with a fair degree of success. Our losses in the various departments have been lowered and some of this reduction in losses can be rightly attributed to sand control. We have endeavored to keep our sand within certain limits for permeability, moisture, green strength and dry strength, for we feel that it is just as important to control the sand as it is to keep the iron mixture within certain limits.

It was the idea of the writer that the sand used for ramming the molds for the same size of pipe would be approximately the same in the various shops, but the testing of the sand used in ramming the mold for a 6 inch pipe from fifteen different shops varied enough to merit a study for the reasons for this variation.

In Table I are tabulated the results of tests of sands from the various shops. It is evident that all four of the factors, permeability, green strength, dry strength, and moisture, varied more than was anticipated.

Different Methods of Ramming Require Different Moisture Contents

The Lynchburg sand with 15 per cent moisture looked very high to us, so we started to lower it. By the time we reached 11 per cent we were in trouble. We found that jolt ramming of the type we used required a wet sand. In jolting a sixteen foot mold vertically the sand toward the top of the mold suffered from aeration when the moisture dropped to 12 per cent. The result was a weak mold at a point about two feet below the bell. Upon pouring, the iron washed this portion badly. On the other hand, with pneumatic ramming, such as is used with sand number one, a low moisture is required. As the moisture goes up on this type of ramming the speed of ramming is cut down and when the moisture is 12 per cent, the speed of ramming is cut almost in half.

Dry and Green Strengths

Strengths, both green and dry, are run on Dietert's shear testing machine, using the permeability specimen for this test. In glancing over Table I, it is noted that there are several sands that illustrate the importance of controlling both green and dry sand strength. Sand No. 1 and sand No. 11 are both used in the centrifugal process for making pipe. In this process the sand problem is an important factor in the success of the plant. Sand No. 11 is used in a shop where the 16 foot molds are rammed by jolting. Sand No. 1 is used in a shop where the molds are rammed pneumatically. I have picked these two sands because they show the importance of sand control better than any other sands in the industry. Sand No. 11 has 3.1 per cent more moisture than No. 1. The reason for this difference is in the method used for ramming.

TABLE I

Sample No.	Permeability	Green Strength	Dry Strength	Moisture Per Cent	Plant
1	313	.7	7.8	6.9	Mono-Cast
2	275	.8	8.8	7.6	Acipco
3	193	.9	8.6	12.4	Acipco
4	119	.55	3.2	10.5	Scotdale
5	358	.75	8.0	10.2	Bessemer
6	300	.7	8.6	13.2	National
7	185	.6	4.0	13.2	Radford
8	380	.5	12.2	14.9	Lynchburg
9	198	.85	2.8	9.8	Clow
10	67	.82	2.4	9.6	R. D. Wood
11	151	.73	11.4	10.0	Sand Spun
12	99	1.0	5.4	13.2	Chatt'no'ga
13	112	1.35	7.8	15.7	Addyston
14	173	.60	1.8	11.9	Burlington
15	156	1.5	9.8	7.4	Clow

The shaking-out process is different at the two plants. In the mono-cast shop the sand is cut out of the flask and in the sand spun shop it is jolted out. If the sand bakes too hard from the skin drying before casting and from the pouring operation, it will be almost impossible to cut the sand from the mold in commercially practicable time. The jolt shaking-out process is not handicapped as badly by this. The sand must be sufficiently strong in the green state to withsand the ordinary handling operations previous to pouring and must dry sufficiently hard to withstand the flow of the metal. A sand low in dry strength washes badly during the casting operation.

In the old style of making pipe, it is necessary to have sufficient green strength to permit the rough handling of the rammed mold from the ramming station to the drying station. The dry strength must be sufficiently great to permit the rough core setting operation to take place without raking of the mold, although it is not always true that the resistance of the mold to raking by the setting of the core is greater with higher dry sand strength. Sand No. 14 in the dry was the weakest

*Presented before the American Foundrymen's Association Convention, June 8, 1927.

ever tested by the writer, yet we saw some of the pipe made from this sand and it looked very good. If the sand is too strong in the dry there is a tendency for the heads of the pipe to drop off. We have had as many as fifteen heads to drop off where the sand was too strong. Where a sand runner is used and pipe are cast bell up, the runner should be strong in the dry. Where the head core is nailed down by nails being placed into the sand runner, the head core will rise if the runner sand is too weak.

Permeability

Permeability plays an important part in the drying operation. We believe it requires less fuel to dry a mold of permeability 350 and moisture 15.0 per cent than it does to dry one of permeability 70 and moisture 9 per cent. When permeability of head core sand is high, we have less trouble from blow holes in the sockets. Oil sand head cores have been used at our Lynchburg plant for the past month with almost absolute freedom from blow holes in the sockets, due largely to the higher permeability of the rammed head core. It is almost impossible to ram the head cores too hard when using oil sand.

Test Methods

Now just a word about the tests. The permeability is run according to the A. F. A. method, though the writer believes the use of one orifice is better than using two. It is very difficult to obtain check determinations on the two orifices on sand No. 8 and sand No. 10. The Dietert shear test machine is an improvement over the compression machine formerly put out by Dietert. The use of the permeability specimen for the strength test saves time and also gives a truer relationship between permeability and strength.

The moisture test as outlined by Dietert will not give reliable results on most of the pipe shop sand given in Table 1. It is almost impossible to check these readings for moisture by actual weighing. On sands like No. 1 and No. 11, and on our sand in the fitting foundry, where we use a sandslinger, moistures can be checked within .3 of one per cent.

In A. F. A. transactions, I see curves giving the characteristics of a molding sand through the entire range of workable moistures. In Table 2A are the results obtained on our sandslinger sand as used in the foundry. In Table 2B are the results obtained by drying the sand at 105 degrees Cent. and retempering to the indicated moistures. Tables 3A and 3B give the same results on our pipe shop ramming sand. The samples are all taken at one time and carefully mixed. Half the sand is used for the determinations in Tables 2A and 3A and the other half in each case is dried and used for the results in Tables 2B and 3B.

TABLE 2A

Permeability	Green Strength	Dry Strength	Moisture Per Cent
62	1.8	28.6	8.9
62	2.2	21.4	8.8
67	2.1	20.6	8.7
62	1.8	15.8	8.8
55	1.9	21.4	8.8

TABLE 2B

Permeability	Green Strength	Dry Strength	Moisture Per Cent	Per Cent Moisture Checked by Weighing
23.4	1.2	5.8	6.0	
33.0	2.5	10.2	7.0	
42.0	3.15	14.0	8.0	
44.0	2.0	16.4	9.0	8.9
38.0	2.0	23.2	10.0	9.7

In Table 2A there is a variation from 55 to 62 in permeability. Green strength checks fairly close. Dry strength, however, is very erratic. In Table 2B the sand when reworked to 9.0 per cent moisture, which when checked by loss in weight showed 8.9 per cent cannot be recognized as the same sand in Table 2A.

In Table 3A on the coarse pipe shop sand the results check fairly well. In Table 3B, however, the sand when reworked to 14 per cent and 15 per cent moisture aside from the higher green strength looks something like the sand in Table 3A. We cannot see and cannot explain why the same sand when dried at 105 degrees Cent. and reworked to its original moisture should not give the same results as were obtained before drying.

TABLE 3A

Permeability	Green Strength	Dry Strength	Moisture Per Cent
275	.5	17.0	14.5
264	.5	19.0	14.3
243	.52	....	....
275	...	18.5	14.5
275	...	....	....

TABLE 3B

Permeability	Green Strength	Dry Strength	Moisture Per Cent
205	.85	11.0	11.0
198	.8	11.8	12.0
236	.7	17.6	13.0
253	.8	18.4	14.0
219	.7	23.2	15.0

Summary

In conclusion we wish to emphasize that, despite the variations obtained on sands used at different shops for making the same casting, there are benefits to be derived from routine sand control. It merely resolves itself to finding the type of sand suited for your particular shop, fixing the limits within which to keep the moisture, permeability and strength and then keeping it as nearly the same from day to day as possible. The results obtained are at least a basis for an intelligent comparison from day to day.

LIMESTONE FOR SEWAGE FILTER BEDS

By J. E. Lamar
Geologist, Illinois State Geological Survey*

PREDETERMINING the suitability of a given limestone for use in sewage filter beds is a problem which is yearly coming to be of more interest to quarrymen and engineers of sanitation. This interest is linked with the growth of towns and cities, the consequent increase in the amount of sewage, and the endangering of public health by improper sewage disposal. As a result, the use of sprinkling and trickling filters has come to be of increasing interest. In a filter recently constructed for a town of 25,000 people, 650 carloads or about 13 trains of limestone were used. It is apparent, therefore, that the initial cost of such a quantity of stone is an important item to a municipality, and that an enduring stone is desirable not only because of initial cost but because of the cost of removing poor stone and replacing it with new material. The problem of sewage disposal during the time required for replacement of the filter stone is still another factor making this operation one to be assiduously avoided.

The study of limestones to determine their suitability as filter stone is new and still in the experimental stage. As yet, very few data are available which correlate laboratory tests and the actual life of the stone in the filter bed. The collection of such data should be the ultimate aim of research and investigation in this line. However, the processes operating to destroy the limestone and their action on the stone may be evaluated, and such tests as are at hand for determining the resistance of the stone to destructive agencies may be applied. Although the only real test of a filter stone is its behavior in the filter bed, the results of the laboratory tests give, at the present time, the most intelligent basis for judging the comparative merits of proposed filter stones. The function of filter stone in a sewage filter is essentially that of a lodging place for bacteria which gather and grow upon the surface of the stone, and by their life processes effect a purification of the sewage.

Causes of Disintegration of Filter Stone

The principal processes effecting the destruction of filter stone in sprinkling and trickling filters are mechanical disintegration and chemical disintegration. These two processes, though they are doubtless greatly cooperative in their action, will be discussed separately, and their combined activity will be taken up in a subsequent statement. Although their destructive effect is slow,—not to be measured in single years—yet ultimately and in the aggregate these processes do produce a greater or lesser destruction of limestone filter media.

Mechanical Disintegration

The most important process producing mechanical disintegration is freezing and thawing. The destructive effect of this process depends on the number of times it is repeated, which in turn is related to the climate and to the operation of the filter bed. During the winter months filters may be operated continuously, or only during the daytime, to treat the more concentrated sewage, or, if the dilution is sufficient, the sewage may be bypassed entirely. In continuous operation in a moderate climate a certain amount of ice forms usually in wide circles around the nozzles of the sprinkler and at the surface of the filter bed. The temperature of the sewage and the biological action are usually sufficient to prevent frost from entering to any considerable depth.

Under severe conditions, such as a sudden cold wave accompanied by wind, the entire bed may become covered with ice. Under these conditions a given portion of the bed may freeze and thaw four or five times during the winter.

In filters in which only the strong day sewage is treated and the night sewage is by-passed, the exposed portion of the bed may freeze at night and thaw again when treated with the warm sewage so that freezing and thawing under certain weather conditions might occur daily, thus affecting the filter stone more severely.

Filters which are not operated during the winter months should be shut down in time to avoid the earliest probable freezing temperature, so that they may drain completely and dry out.

Freezing and thawing disrupts a stone principally by reason of the fact that when water changes to ice it expands about 1/10 its volume. Therefore, if a stone is saturated with water, and the water freezes, the stone will be disrupted unless it has sufficient strength to overcome the force of the expansion accompanying the change of water to ice in the sub-surface pores. In the surface pores the expansion accompanying freezing is probably partly accommodated in the open direction of the pore, but not always sufficiently to eliminate disruptive stresses completely. Though a stone may withstand the forces occasioned during the freezing of water in its pores and in pits or pockets on its surface for a number of repetitions of the process, it eventually gives way and fractures or chips. Inasmuch as there is inherently

*Report of Investigation, Number 12, Division of the State Geological Survey, Illinois.

less resistance to breakage in the surface portions of a stone, other things being equal, the common effect of freezing and thawing is a chipping or scaling off of the surface.

Although not nearly so important as freezing and thawing, the expansion and contraction of the stone in a filter bed, as the result of heating by the sun's rays in the summer and subsequent cooling by dousing with sewage, is doubtless a contributory factor in the destruction of filter stone. The effect on the stone would probably be to cause it to chip or spall.

Factors Influencing the Rate of Mechanical Disintegration

The pores of a stone which can be penetrated by a liquid must have a connection with the surface of the rock and therefore the amount of water a stone can absorb is related to the volume of the connected pore space it possesses. This porosity is an important factor governing the effectiveness of freezing and thawing in destroying the stone. The distribution and size of the connected pores is also important in this regard. For example two stones may have the same porosity, the first with evenly distributed small pores, and the second with but a few large pores concentrated in a given zone; the second would fracture more quickly than the first, other things being equal, because of the concentration and localization of the stresses set up in the few larger pores of the stone by repeated freezing and thawing.

Limestones in general may be grouped into three main classes according to their texture as apparent to the naked eye, namely, crystalline, non-crystalline or dense, and granular. There are some limestone formations which fall definitely into one of these three classes, but in general limestones have such a variety of texture that any two or even all of the above classes may be embodied in one formation. The terms are of value, however, in expressing the relative importance of the three textural divisions for purposes of discussion. There is a definite relation between the physical structure of filter stone and its resistance to disruption, for the strength of a crystalline limestone depends on the degree of interlocking of the crystals or, if the stone is granular, on the completeness of the bonding of the granular material. A stone which appears crystalline to the eye is likely to have well-interlocked grains. A stone which appears non-crystalline may or may not have well-interlocked crystals. All limestones when examined microscopically under sufficiently high magnification are seen to be composed, to a greater or lesser extent, of crystals of calcite; if the stone is a dolomite, the crystals are calcite and dolomite. Therefore, some limestones, non-crystalline to the eye, are simply so fine grained that the individual crystals are not megascopically recognizable. In many limestones appearing to the eye either crystalline or non-crystalline, though more frequently the latter, clay is present in varying amounts. This clay, in general, lessens the strength of the stone because it interrupts the interlocking of grains or coats them at the planes of contact. In some rocks the clay is segregated in zones or thin bands through the stone which often constitute planes of weakness. In the case of siliceous limestones, crystals of silica, either localized or evenly disseminated through the stone, will be found interlocking with or replacing the calcite crystals.

In granular limestones composed of fossils, fossil debris, colite grains, or calcareous debris of any sort, the strength of the stone depends to a large degree on the completeness of the bond effected between the granular material and the matrix on the strength of the bonding substance. In many limestones the bond is very good; in others a thin film or organic material surrounds many of the granules or fossils and consequently interrupts the continuity of the bond.

Some limestones possess a distinct bedded or laminated structure which exerts an important influence on the ability of the stone to resist disintegration. The bedded structure is not the gross feature of bedding but rather minor, abrupt variations in the texture of the granular or detrital materials composing the stone within a larger bed. The laminated structure is not generally visible to the eye in fresh specimens, but is unusually revealed during the accelerated soundness test by a flaking or splitting of the stone into thin sheets or laminæ. Inasmuch as the contacts of texturally unlike sedimentary materials are often planes of weak, partly or wholly interrupted bond, a stone having a bedded or laminated structure should be thoroughly tested before it is accepted as filter stone.

Chemical Disintegration

As long as a sprinkling filter is in operation, all of the stone in the filter bed is being repeatedly doused with the effluent from the settling tanks. In ordinary domestic sewage this effluent is largely water, but it contains carbonic acid and possibly a number of fatty acids. Although both are in very dilute solution they doubtless dissolve a relatively small but still appreciable portion of the filter limestone in a period of years. Furthermore, the bacteria growing on the stone produce carbon dioxide which forms carbonic acid. There is some question, however, as to whether the net effect of the coating of bacterial jelly is not more protective than injurious as regards solution of the filter stone.

Considering the effect of solution on limestones and dolomites, it is noteworthy that dolomites, though more soluble than limestones, are less rapidly soluble. The rate of solution is of importance

TABLE 1.—VARIATIONS IN PHYSICAL TESTS OF NIAGARAN DOLOMITE

District	No. of Samples	Water absorbed Lbs. per cu. ft. Max.	Min.	Variation	French coefficient Max.	Min.	Variation	Hardness Max.	Min.	Variation	Toughness Max.	Min.	Variation
No. 1	21	4.89	0.76	4.13	12.5	3.9	8.6	18.1	12.9	5.2	13	5	8
No. 2	24	4.98	1.39	3.59	10.8	5.6	4.2	15.3	9.0	6.3	10	4	6
No. 3	34	3.50	0.56	2.94	10.8	5.9	4.9	16.0	11.3	4.7	11	4	7

because the movement of the water through the filter bed defeats any chance of saturation of the dissolving medium, thus nullifying the effect of differences in solubility, and facilitates the solution of the more rapidly soluble substance. The rate of solution of a stone, however, is influenced by an additional factor, namely, the area of surface exposed to the solvent. The larger the arc the greater the potential rate of solution. In general, dolomite, as a result of the manner of its formation, is more porous than limestone, and consequently exposes a greater surface to the solvent than limestone. This tends to and may practically equalize in the net result the difference between the two rocks in rates of solution.

If a piece of limestone or dolomite with a plane surface is immersed in hydrochloric acid for a brief time, it will be found that certain parts of the stone have dissolved more rapidly than others (figures 1-5). In some stones, the fossils, fossil debris, vein fillings, and the like dissolve the more rapidly and in others, the matrix. In still others the effect of the solution is about equal over the area exposed. If the stone is very pure, solution will leave a surface nearly similar to the original one; if, however, the stone is an argillaceous or siliceous limestone or dolomite, a protective residual coat will remain. If the residual coating is firm and hard, it is an asset in hindering further solution. The effect of selective solutions on any given portion of the stone is to increase the surface porosity. As a result additional surface is made available to the action of the solvent, and the opportunities for mechanical disintegration are increased. The matter of selective solution is thought to be the crux of the potential destructive effects of solution on filter stone. A stone of even texture and uniform solubility would apparently be desirable to offset the effects of solution.

Because of the frequent wettings and complete or partial dryings to which filter stone is subjected, the process of oxidation is greatly facilitated. Substances which oxidize are, therefore, to be consistently avoided. Probably the worst offenders in this class are pyrite and marcasite, both sulphides of iron. These oxidize to limonite, the hydrated oxide of iron, which occupies more volume than either of the sulphides. As a consequence, oxidation of either of the sulphides to limonite is accompanied by forces tending to disrupt or weaken a stone if they cannot be accommodated by free outward expansion as in surface pores.

TABLE 2.—HYPOTHETICAL ACCELERATED SOUNDNESS TESTS

Sample No. 1 No. immersions and dryings	No. pieces failing	Product	Sample No. 2 No. immersions and dryings	No. pieces failing	Product
11	4	44	10	6	60
15	7	105	12	6	72
20	12	240	15	8	120
21	19	399	20	10	200
22	20	440	26	12	312
24	17	408	27	12	324
28	11	308	28	28	784
31	8	248	31	16	496
48	2	96	42	1	42
			44	1	44
	100	100) 2,288		100	100) 2,454
		Av. 22.88			Av. 24.54

It is possible that some limestones contain clay minerals along bedding planes, or less probably in a disseminated state, which absorb water as a result of the constant wetting to which they are subjected, with an accompanying increase in volume. This increase would have the same general effect as that resulting from the change of pyrite into limonite.

Co-operative Effect of Mechanical and Chemical Disintegration

As previously stated, it is very difficult to divorce and indentify singly the effects of mechanical and chemical disintegration, respectively, on a filter stone. Mechanical disintegration increases the surface area available for the agents of chemical disintegration. Chemical disintegration, in turn, if it is selective, results in an increase of porosity and favors further mechanical disintegration. Without doubt the upper foot of the filter bed is the zone of maximum effect of combined mechanical and chemical disintegration. It seems likely, also, that the basal two or three feet of a filter bed are the most favorable for chemical disintegration not excepting the process of oxidation.

Properties Desirable in Filter Stone

From the foregoing discussion of the agencies causing the destruction of filter stone, the following properties seem desirable in filter stone:

(1) The stone should have a minimum volume of pore space connected with the surface.

(2) The pores of the stone should be small and evenly distributed.

(3) The stone should consist of well-inter-

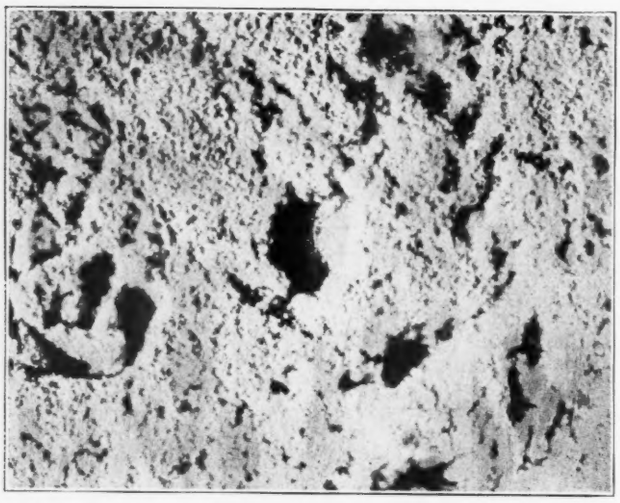


Fig. 1. Niagaran dolomite. Maximum surface relief about 1 mm. The etching has enlarged the surface pores and has left the specimen coated with fine dolomite crystals which may be easily brushed off. The effect of surface etching or solution of the calcium carbonate from dolomite limestone is augmented by the consequent freeing of dolomite grains; hence the actual weight of dolomite disintegrated may in some cases be equal to or greater than the weight of limestone dissolved by simple solution under identical conditions. This specimen chipped slightly after 8 repetitions of the soundness test, but thereafter remained intact through the remainder of 20 repetitions. (Magnification six times.)

locked crystals or if it is granular, the grains should be firmly bonded by a strong cement.

(4) The stone should be of uniform solubility.

(5) The stone should be free from minerals

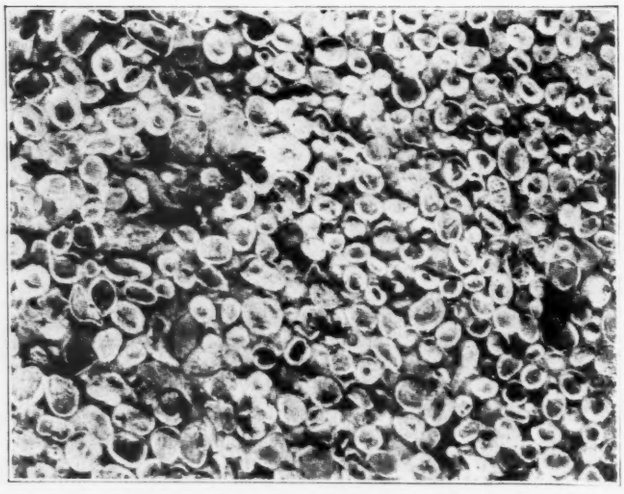


Fig. 2. Ste. Genevive oolitic limestone. Surface relief about 0.2 mm. The etching has affected the stone very evenly but was slightly more pronounced on the white outer portions of the oolite grains. Near the center of the right margin of the illustration, a hexagonal quartz grain which is the center of an oolite grain projects above the general level of the surface and casts a pronounced shadow. That this specimen showed no disintegration after 20 repetitions of the soundness test indicates a good bonding of the granular material of the limestone. (Magnification six times.)

which oxidize or hydrate. Pyrite and marcasite especially are to be avoided.

(6) The stone should have a sufficiently rough surface to furnish anchorage for the bacteria which are to grow upon it.

(7) The stone should be comparatively pure chemically. Stones with high clay contents are generally to be avoided. A high siliceous content is probably not harmful if the silica occurs in fine crystals evenly disseminated.

(8) The stone as delivered to the filtering plant should be free from dirt or fine rock particles which might collect in and clog the basal portion of the filter bed.

Testing of Limestone and Dolomite Filter Stone

Certain tests may be made on limestones and dolomites which individually indicate the relative value of specific properties of a stone. It is impossible, however, exactly to duplicate conditions in nature and at the same time accelerate in a laboratory the combined effects of mechanical and chemical disintegration. Therefore, the results of any set of tests are indicative rather than absolute. Nevertheless, as such they serve a purpose. The following series of tests, though doubtless not in their ultimate form, appear to give valuable data concerning filter stones and will serve, as well, as a basis for devising improved tests.

It is natural in developing a new set of tests for a certain material, to turn to known tests and attempt to adapt them to the work at hand. In an endeavor to find adequate tests for filter stone, engineers have turned to the tests made on limestone highway aggregates, and accordingly have employed the toughness test. Considering the first three tests as a whole, they indicate the resistance of rock to repeated impact and to wear and abrasion. Inasmuch as it does not seem probable that impact, wear, or abrasion plays any important part in the destruction of filter stone, it would appear that these tests might be dispensed with. However, since the results of the hardness, toughness and wear tests and the percentage of water absorbed are in most cases the only data available from the numerous tests of various stones for aggregate, these data may give clues as to range and character of the regional variations in a given limestone formation. For example, Table 1 gives data on the variation in the physical properties of the Niagarain dolomite in the three principal areas in which it is quarried in Illinois. From the table it appears that the stone from district No. 1 is likely to be more variable than the stone from districts Nos. 2 and 3 and consequently stone from that district should be more carefully and frequently sampled than stone from the other two districts.

Regarding the physical tests shown in Table 1, only the water absorption, discussed later, is individually significant. Although it may be said that rocks satisfactorily passing the above mentioned

tests from the standpoint of highway material will probably pass the accelerated soundness test, there are known to be exceptions which make it highly desirable that the soundness test itself be applied. This test, if applied, practically eliminates the need of hardness, toughness and wear tests for filter stone.

The accelerated soundness test, also known as Brard's test or as the quick weathering or sodium sulphate test, consists of immersing a representative sample consisting of pieces of two-inch stone in a saturated solution of sodium sulphate for 20 hours and then drying it at a temperature of 100 degrees Cent. for 4 hours. The process is repeated 5 times in testing highway aggregate, and the stone showing no disintegration is considered satisfactory aggregate. Stone which fails under this test is considered as doubtful until other tests prove or disprove its value.

The theory of this test is that the saturated sodium sulphate solution penetrates the pores of the stone during immersion. When the stone is dried, water is driven off and the sodium sulphate crystallizes and the growing crystals set up stresses within the stone. The process simulates in net effect, therefore, the action of the freezing of water in the pores of a stone. The crystallization of the sodium sulphate in the pores of the stone, however, appears to exert a greater destructive force than does the crystallization of water, and as a consequence the test is much more severe than normal freezing. Experiment has shown that sodium sulphate crystallizes in three different forms and consequently may not always give comparable results. Sodium chloride is therefore suggested as a substitute of similar action as it crystallizes in one form only.

The test should be of great value in testing filter stone, inasmuch as it simulates natural mechanical disintegration and depends for its effects on essentially the same factors. The amount, distribution, and character of the porosity are involved, as are also matters of bond strength, and crystal interlocking. Since filter stone is subjected to more severe conditions of mechanical disintegration than is ordinary concrete aggregate, it should certainly be required to pass a minimum of five repetitions of the soundness test. The stone not passing this test should be regarded with suspicion.

The U. S. Bureau of Standards which has been making studies of weathering tests, states that the effect of one crystallization with sodium chloride is equivalent to about eight water freezings. Sodium sulphate is at least equally severe in its action. There is, however, considerable variation of the ratio in different types of stone. The studies of the Bureau of Standards have been confined largely to limestones and sandstones and, to date, indicate a general average of about 1,000 freezings to produce disintegration, though some specimens have shown no disintegration after 2,000 freezings. These results suggest that with a correlative value of 1 to 8 for sodium chloride and water crystallizations, the ultimate strength of many limestones would not be reached with less than 100 repetitions of the soundness test. Possibly the best method of application of this test is to continue treatment of a representative sample of 50 or 100 pieces of stone till all show failure. As the respective fragments fail, they could be removed and the number of immersions and dryings recorded. When all pieces had failed, an average could be struck by multiplying the number of pieces failing by the number of immersions and dryings withstood without failure by each, totalling the product and dividing by the number of pieces used. This would give the number of immersions and dryings necessary to disrupt an average fragment of the entire sample. The stone having the highest average number would theoretically be the best. For example, hypothetically, of two samples failing as shown in Table 2, sample No. 2 would be the better stone.

It is highly desirable that, in conjunction with this accelerated soundness test, the resistance of the stone to weathering in the natural outcrop be also considered. It is generally possible to find outcrops of a given stone near a given quarry which have been exposed to the weather for many years. From these outcrops many points of interest may be gathered concerning how the stone is likely to weather. The loose material at the base of a cliff is likely to yield the most valuable data.

The freezing test, consisting of alternately freezing and thawing water-saturated specimens, is preferred by some for determining the weather resistance of a stone. It is a slower and more tedious process than the accelerated soundness test, and requires much more apparatus. It is somewhat doubtful if the greater accuracy claimed for this test compared with the accelerated soundness test warrants the extra time and equipment required in testing material like filter stone which is to be subjected to extremes of mechanical disintegration.

This test is designed to measure the volume of connected pore space by determining the amount of water absorbed by a stone in 24 hours. A representative sample of about 1,000 grams is dried at 100 degrees C. to 110 degrees C. to a constant weight, and its weight carefully determined. It is then immersed in water for 24 hours, removed, surface dried, and reweighed. The amount of water absorbed divided by the weight before absorption multiplied by 100 gives the percentage of absorption. This test is of great value as supplementary to the soundness test.

It is often possible by microscopically studying thin sections of the typical phases of a limestone, to predict the general results of the soundness test and possibly eliminate a large amount of labor. Such examination reveals the size of the crystals

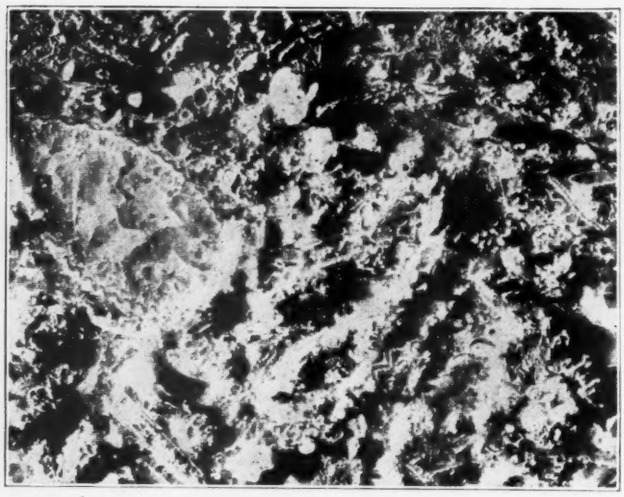


Fig. 3. Chester limestone. Maximum surface relief about 1 mm. This is a very pure limestone composed of fossil debris bonded by calcium carbonate. Etching has dissolved the calcium carbonate and left the fossil debris projecting from the genreal level of the surface. At the right of the picture is a brachiopod which has been filled with calcite. After 16 repetitions of the soundness test this specimen broke into three pieces along a large fossil. There was no breakage during the four subsequent repetitions of the test. The resistance of this specimen to the soundness test is evidence that in general it is well bonded. (Magnification six times.)

and the condition of crystal interlock or, if the stone is granular, the character of the granules and the bond. Minute clay partings, grains of pyrite or other foreign minerals, and the distribution and

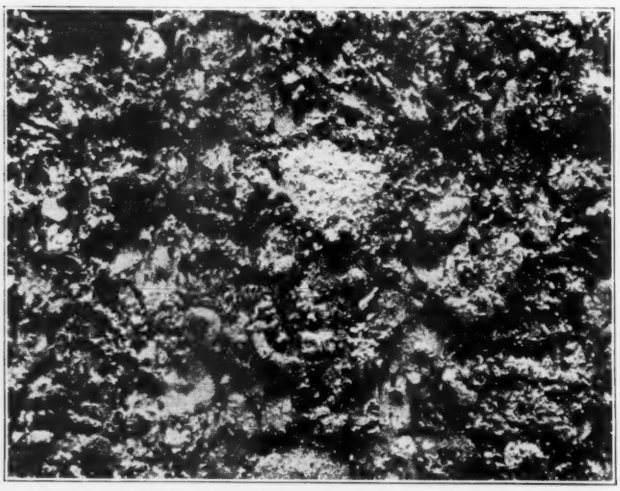


Fig. 4. Chester limestone. Maximum surface relief about 1 mm. Etching has removed the calcium carbonate cement and left the clayey, siliceous impurities of the stone as projections above the general surface. Disintegration of this specimen began after 4 repetitions of the soundness test, and complete failure resulted after 8 repetitions. The disintegration of the stone into a coarse sand showed that the bonding material was weak. (Magnification six times.)

size of the pores are also revealed. Hirschwald has proposed a classification of limestones and dolomites, repeated by Howell which divides these rocks into 24 different groups, into one of which almost every limestone may be placed. This classification may be used to standardize terms descriptive of

Fig. 5. Pennsylvania limestone. Maximum surface relief about 1½ mm. This is a siliceous limestone containing fossils composed of calcium carbonate. These were dissolved during the etching and gave rise to the linear depressions. After 6 repetitions of the soundness test this specimen began to chip and split along the surfaces of fossils. After 11 repetitions, disintegration of the entire specimen was complete. This sample shows the type of results which may be expected in limestone with a localized porosity. (Magnification six times.)

texture, but the interpretation of the phenomena shown in a thin section depends chiefly on the skill of the examiner and his knowledge of applied sedimentary petrology.

Under the discussion of chemical disintegration, the various effects produced by selective solution have been pointed out. In order to determine how a limestone or dolomite will dissolve, a number of representative pieces of stone should be ground so that each piece will have one flat surface. The pieces should be selected so that the flat surfaces constitute sections parallel to and at right angles to the bedding. These pieces should be set with the flat surfaces up and parallel to the bottom of a shallow dish, to prevent the production of irregularities by carbon dioxide currents, and then covered with a 10 per cent solution of hydrochloric acid. The etching action of the acid should be allowed to proceed until its effect is clearly apparent on the smoothed surface. The distribution and character of argillaceous and siliceous materials, partings, sand grains, and pyrite are usually revealed after etching (figures 1-5). The stone showing the minimum of undesirable impurities and the minimum development of porosity, or, otherwise stated, the most even solution, is likely to be the more desirable other things being equal.

The only truly satisfactory method for determining the rate of solution of filter stones is to subject a representative and carefully weighed sample to continual dousing with sewage water for a period of weeks and then to clean it thoroughly and weigh it. This process often takes too long to be of service where an immediate report is necessary. Comparisons may be made of limestones as a group, and similarly by dolomites, by cutting cubes of stone of the same size, weighing them, and immersing them in very dilute hydrochloric acid for a given time. The loss of weight gives a basis for calculating the amount which has dissolved. No tests have been developed for determining the relative rates of solution of limestone and dolomite in

cold dilute hydrochloric acid in which limestone is more rapidly soluble than dolomite.

About 100 grams of stone as representative of the deposit as possible, crushed to pass a 10-mesh sieve and retained on a 20-mesh sieve, is treated with hydrochloric acid until effervescence ceases. The residue is collected on a filter paper, washed free from acid, dried and weighed. The relative proportions of such materials as clay, silt or sand, are recorded as well as other items of interest concerning the presence of secondary silica, chert or flint and mineral grains. The presence of pyrite or marcasite is readily determined in this test. It is indicated in the chemical analysis as iron and sulphur, but such an analysis does not differentiate between iron present as the hydroxide and sulphur present in compounds other than iron sulphide.

A chemical analysis showing the percentages of the following compounds in limestones and dolomites is important because it indicates the general composition of the rock for filter stone: Calcium carbonate, magnesium carbonate, iron oxide, alumina, silica, and sulphur. These compounds are involved in a consideration of the resistance of a stone to disintegration. It is recommended that these tests be made in accordance with the procedure outlined by Hillebrand for the analysis of carbonate rocks.

Why Commercial Vision Is Imperative

Vision is the unimpaired recognition of the future. Never has the business man stood in greater need of vision for never in history has any nation progressed with greater speed than ours. So rapidly are we traveling that what was true yesterday is untrue today and dangerous tomorrow. Dangerous because any calculation of the future based on past experience is more than likely to be unreliable and misleading. A few short years ago we could profitably employ statistics and measurements of business that were one or two years old. Today such figures no longer serve because of the radical changes than can be effected in so short a period as one year.

The rapidity with which we are progressing is shown in countless ways. Two and one-half years ago our rayon industry produced goods valued at only 59 million dollars. Today the annual production of rayon products totals a value in excess of 125 millions, and this 1925 figure contrasts itself with the $4,597,000 which was the value of the 1914 production.

Perhaps the reader's reaction to the above paragraph is that an industry of only 125 million dollars should cause no stir in one's imagination, and certainly none in the commercial world. Perhaps not. The rayon industry is doubtless below the 100 mark in proportionate industrial classification. But 27 years ago there were only 17 industries in the country whose net value exceeded 100 millions, only 38 totaled over $50,000,000 with only one in the billion dollar class. Today there are 114 industries rated above 100 million and 19 with value exceeding one billion.

Perhaps the greatest and most rapid single increase ever enjoyed by any industry has been experienced by radio. In 1923 (2½ years ago) the industry is reported to have been valued at $44,176,000. Today its value is considerably in excess of $650,000,000—a total that contrasts itself with the 1914 figure which was $792,000.

The most illuminating and valuable thing about such a recount as this is the forced realization that is short spaces of time our most inconspicuous industries can rise to full importance. What will be our major industry in 1950? In ten years? Such a question could be answered only by conjecture, and conjecture, traveling at our present speed, is exceedingly dangerous. We need more up-to-date statistics and trend figures. Only by these can we hope to gain unimpaired recognition of the future.

Employment Survey Completed

A survey just completed by the National Association of Manufacturers shows that the industries of the nation are now operating, and will continue to operate for the next three months, on the remarkably high basis of more than 81 per cent of their maximum employment capacity.

Nineteen per cent of these plants are now running at their full employment capacity, and 29 per cent are operating with 90 per cent of their maximum forces. The association sent questionnaires to 3,000 members of its organization in pivotal sections, from the Atlantic to the Pacific, for an instantaneous reflex of the employment situation. The questionnaire went to companies with payrolls ranging from as small as a dozen hands to companies with 40,000 employees.

Replies were received from 2,203 companies, and these reported that the number of employees required in their plants to maintain maximum capacity, was 1,509,920, an average of 685 per company; and that they now have under employment 1,227,325 or an average of 557 per company. This survey encompasses all industry and even includes many seasonal industries that are now at their lowest production scale. As compared with employment at the same time last year, this shows an actual falling off of less than 3 per cent.

The survey covered twenty-three classifications of industry: Agricultural machinery, automobiles, automobile accessories, builders' and plumbers' supplies, chemicals, clothing, electrical and radio, food, furniture, glass, hardware and tools, instruments, jewelry, leather, lumber, machinery, music, printing, pottery and clay, rubber, steel and iron, textiles and miscellaneous.

Thoughts for Your House Organ

If yours is a large establishment, or one in which 100 or more employees are employed, you doubtless have a periodic internal house organ. If such be the case and you are operating without a well edited house magazine, we suggest its serious consideration, for such publications have proved time and again the most efficient and economical means for the betterment of employee relations.

One of the countless good ideas such a magazine can carry to your employees is that of promotion and successorship. Entirely too many foremen and "rubber stamp" department heads have the idea that to teach another person the intricacies of their particular job, they undermine their own value to the company. Such fallacious reasoning should be counteracted by the policy of promoting no one within the organization who has not provided a competent understudy. It should be thoroughly drilled into every employee that to train the next lower down to the job just ahead is not only proper but necessary to the welfare of the company,—and the individual. The idea of "losing my job if everybody knows all about it" should be stamped out and substituted with the idea of "learn my job and I'll learn the next above."

Countless ways have been employed to get constructive ideas regarding the operation of the plant from the employees. Suggestion systems and roundtable discussions, prize awards and private interviews, have all been tried with varying degrees of success. Your magazine is perhaps the best medium for the encouragement of constructive suggestions. Through it foremen and supervisors can be told to consider seriously any suggestion that is made. Through it the worker can be assured that the world has moved ahead by climbing over the bruised forms of assaulted ideas —that it has gained its present emminence only because a few were possessed of constructive ideas.

There is no better way to encourage individual initiative or private research than through a well written house organ editorial. Every employee should know that just the moment he has found a better material or more efficient method then liberal reward awaits its submission and successful trial. The alchemists of old sought to convert the baser metals into pure gold and thereby gain riches. Countless thousands have since and are still trying to do the same thing. Irrespective of their success, these researchers have given the world many of its present chemical truths. They sought for something which perhaps they never could find, but in so seeking they discovered something else quite as worthy. So it is with the employee who has an idea about material handling, processing, management or what not. His idea may be utterly without value to the application suggested, but it may be invaluable to some other department.

Steadiness and reliability are prerequisites to success. Too many of the younger employees fail to appreciate that fact. Just now literally thousands of college and university graduates are entering the field of business with heads up, hearts courageous, and ambitions high. Where will be their enthusiasm three years hence when they have had forced upon them the realization that "heaven is not attained in a single bound?" That depends largely upon your attitude toward them. In the race for success, which is, after all, only another form of competition, many become discouraged; but discouragement sets in or becomes noticeable only when a constant new supply of encouragement is never pumped in. Gently and persistently these young business enthusiasts can be told that nothing is easy—that if they didn't have to work half a lifetime for success, there would be little of value to that success. Simultaneously with this deflation of optimism, there should be the proper degree of logical encouragement injected to forestall the development of pessimism.

As a final thought—there isn't an industrial house organ in all business that shouldn't command the serious attention and editorial powers of the highest executives. Constant and proper supervision of a house organ by the management—not the plaything of a $60-a-week "writer"—should provide a medium through which much of a constructive nature may come.

Cities Subject to Damage Suits When Competing in Business

A Lansing, Michigan, city garbage disposal truck struck the automobile of Mrs. Katherine Foss, wrecking it and injuring her. She sued the city for $20,000 damages. The circuit court saw nothing unusual in the case and gave Lansing the usual immunity on the grounds that the truck was discharging governmental functions and possible negligence of its driver did not enter into the case.

It is developed, however, that the city operates a piggery for profitable use of garbage and enjoys a profit on it. The Michigan Supreme Court held that wherever a governmental unit enters the field of private enterprise, no matter to how limited an extent, it immediately shoulders the responsibilities of private business and is liable for acts arising from this invasion of profit making activities. Since the city had so far departed from strictly governmental functions, its garbage trucks became instruments of profit, and their owner became liable for them.

PROSPECTS AND PROBLEMS OF BUSINESS PROSPERITY

By Virgil Jordan
Chief Economist, National Industrial Conference Board*

THE great question in the minds of American business men today is whether the novel conditions of the last five years have become permanent characteristics of American business, and if they have not, when they are going to change and how. The politician is also interested in the puzzle of present prosperity, in view of the rapid approach of a presidential year when things should be peaceful but usually are not. Perhaps the professional economic prophets are the most worried of all and deserve the most sympathy, because their old charms and incantations no longer work as effectively as they used to in evoking pleasant or horrible visions of the future. The soothsayer's spells have weakened, their clients' confidence wavers, subscriptions fall off, and, naturally, profound pessimism prevails, for prophets are most prosperous when business is worst.

The fact is that if business forecasting, in its present stage, were not largely voodooism, there would be nothing to forecast, because nothing unusual would happen. Strictly scientific business forecasting, if it were possible at all, would defeat itself; for if all business men planned their operations in the light of full knowledge of what all others were going to do, the extravagance of optimism and pessimism would be avoided and stability would result. The things that the forecaster prophesies take place because he makes everybody expect them to take place, not because there is anything in our economic life that makes them necessary.

The prevalent attitude of the business world toward the future is a kind of barbaric religion based on ignorance and fear. The American business man particularly has become so obsessed with that strange combination of economic Puritanism and superstition which is called the business cycle that he has lost his ability to believe in or work for stable economic progress. The fluctuations in industry and trade which have been incidental to the steady growth of the nation have been more impressed upon his attention than has that steady growth itself, which has gone on irresistibly through even the greatest upheavals like the Civil War and the World War. In consequence, the business community have missed the really significant features of the business situation during the past five years.

The business man is afraid and the business forecaster is hopeful of a good old-fashioned depression

Virgil Jordan

next year, because both of them imagine that since 1924 we have been enjoying an old-fashioned boom, and that in punishment for a little prosperity we must have a great deal of depression. The press, public officials and many business men themselves have helped to spread this misconception by talking in large terms of "economic miracles" and "unprecedented records" of this, that or the other, while foreign observers, making a tour of the country through our best hotels, have hailed American prosperity as the "wonder of the age."

In the course of time, however, it is likely to become evident that we have not been enjoying an old-fashioned boom. The only real inflation that has taken place has been an inflation of language and to some extent of the stock market. There has, it is true, been a shifting of production and trade from old lines to new, and tremendous changes in our methods of production and trade. Certain lines of activity have shown an extraordinary growth since 1922, but these have been chiefly

*Presented before the New York State Bankers' Association, at Albany, June 7, 1927.

lines which are indicative of a rapidly growing demand for luxuries which have been the first fruit of a rising standard of living. These lines of trade and industry, however, are not representative of American business and American production as a whole. The bulk of our economic activity has increased very little more than the normal growth would imply, and in many basic lines conditions have been distinctly sub-normal. The shifting of prosperity from particular lines of trade and production to others has been characteristic of our economic development throughout the past fifty years, and is by no means an indication of boom periods.

In fact, the outstanding features of the past five years in our business life are more characteristic of sub-normal general business than they are of boom or inflation conditions. Commodity price levels have been declining, wages have been maintained at high and stable levels, there has been a premium upon efficiency in production, competition has been intense, profit margins have been narrow, agricultural purchasing power has been depressed, and interest rates have been low. All these and other symptoms make the past five years look very different from a real old-fashioned boom. Our enormous credit resources have, in fact, not been utilized in the expansion of trade or production to anything like the extent they have in the inflation of security or real estate values.

The real danger, if there is any, lies not in the prospect of any real depression, but in the possibility that a real boom period may take place in the near future, with a rising price level and all of the ordinary symptoms of the usual kind of inflation. If this takes place, we may look for the restoration of the old-fashioned business cycle and for increased prosperity among business forecasters. Whether it does take place or not will depend upon the extent to which business men clearly understand the significance of the changes in our business life during the past five years and appreciate the power which lies in their hands to stabilize our business progress in the future through intelligent, organized self-control.

Electric Arc Welded Machines

What promises to be a revolutionary step in the manufacture of electric machinery is the adoption of electric arc welding for the fabrication of many types of machines by the General Electric Company. This method, which has recently attracted world-wide attention because of its possibilities in replacing rivets in the construction of buildings, was first tried out in the construction of electric machinery by the General Electric Company some years ago. The many advantages which attended its use soon became so obvious that its field was rapidly widened.

More Cement But Less Profit

Although production of portland cement for 1927 may exceed that of the banner year 1926, when the output totaled 164,057,000 barrels, net earnings of the industry are expected to be somewhat less. While some of the larger producers will show good profits, many of the smaller concerns, especially in the territory east of the Mississippi, will find it difficult, owing to recent cutting of cement prices, to report satisfactory returns.

The two chief factors to bring about this condition, according to the Wall Street Journal, are the competition among manufacturers and the dumping of output by European mills on the Atlantic seaboard, the latter cause having the more damaging effect of the two. While imports of 3,200,000 barrels would seem to be insignificant compared with a total domestic production of 164,000,000 barrels, they become important when dumped into a restricted territory, causing mills built to serve that field either to seek other markets, to meet the price of the imported product or to curtail production. In the quest for other markets the American producer must invade sections already well supplied, thus aggravating the situation and causing additional competition.

American producers are handicapped in that, under the law, they cannot cooperate to repel foreign competition, whereas European producers are encouraged by their governments to form cartels effecting allotment of tonnages in various American markets. How easy it is for the European to injure the American producer is seen in the case of New Orleans. The nearest cement-producing district for that city is at Birmingham, Alabama. The freight charge from there to New Orleans is 72 cents a barrel, whereas the rate from Europe is only 40 cents, cement being carried as ballast by foreign vessels returning to that port practically empty.

The matter of wages also enters largely into the question of foreign competition, the American cement worker receiving $4.50 a day whereas labor can be had abroad for 90 cents. Belgium, which supplies 74 per cent of the cement imported into this country, is making great strides in this industry, and has doubled its production in the last four years. Other prominent foreign competitors are Great Britain, Denmark, Sweden and Norway.

Another factor which is disturbing manufacturers is the great expansion in the productive capacity of the United States. The practical capacity today is estimated at 200,000,000 barrels. In addition 22 mills are being built or projected with a potential output of 20,000,000 barrels. On the other hand, to partly offset this, the industry continues to find new outlets for its product and to expand its utilization. Cement roads in 1926 alone required more than 40,000,000 barrels.

PIT AND QUARRY FOREIGN DIGEST

Report of British Stone Preservation Committee

Before recommending methods of preservation of stone, a detailed examination of the causes of stone decay is being made. The microstructure of building stones, as revealed by an examination of sections mounted in a specially developed resin, is of great importance, and the distribution of the pores of the stone, that is, of the surface open to attack, is probably a preponderating factor in determining the rate of attack. There is very little data on this subject as revealed in previous researches and this lack of information probably accounts for the widely differing results obtained in practice with the usual methods of preservation, as, for example, by washing with lime. Experiments are being made with test pillars treated with various preservatives which appear to offer the highest initial resistance of attack. Bacterial investigation has led to the isolation of a variety of bacteria apparently peculiar to stonework. (Dept. Sci. Ind. Res., March, 1927, 33 pp.)

Phases Produced in Burning of Kaolin

The first phase produced in the dehydration of kaolin is Metamacrite, a phase consisting principally of what appears to be a pseudomorph. The refraction of light decreases with increasing loss of water. In 6 per cent hydrochloric acid, Al_2O_3 dissolves, and a 12-hour treatment on the water bath brings one molecule Al_2O_3 into solution in two molecules of water. The index of refraction of the residual SiO_2 skeleton is 1.440. It dyes with methylene blue, and has a distinctly double refraction, which disappears after a few days. At a temperature between 850 and 1200 degrees a second product is formed which possesses a distinct "powder Roentgenogram." The alumina is insoluble in HCl. The refractive index is 1.530. Treatment with 10 per cent NaOH dissolves a considerable part of the SiO_2 and a little Al_2O_3. The Na_2O is combined in the reaction product in permutitic form. Above 1200 degrees a third product is formed with a refractive index of 1.56-1.57. No absorption of NaOH occurs. It dissolves SiO_2, so the product lies between Sillimanite and Mullite. K. Spangenburg (Fortschr. d. Mineral., Krystallogr., Petrogr. 11, 340-343. Kiel).

Hardening of Roads Containing Silicates

Stony or calcareous materials are hardened by a solution of sodium silicate (SiO_2—24.9 per cent; Na_2O—7.3 per cent.). Gelatinous silica separates out and afterward coagulates, thus binding the particles of stone to a resistant and insoluble mass. This effect occurs by means of absorption, and since it is favored by drying, dialysis and the action of carbon dioxide, the different effects obtained under various working conditions may be explained. R. Feret (Compt. Rend. 1927, 184 935-7).

Exploitation of the Magnesium Lake in the Crimean Peninsula

For the formation of a magnesium mortar from MgO and $MgCl_2$ solution, the magnesium chloride solution does not need to be chemically pure. Useful mortars are produced by mixing MgO with the raw solution from Staryi Lake (in North Crimea). The salt solution contains 25 per cent $MgCl_2$, 3.4 per cent $CaCl_2$ and 1.8 per cent NaCl. The best test mortar has a shearing strength of 85 kg. per sq. cm. Salt solutions containing less $MgCl_2$ and more NaCl give mortars of lesser strength. Crystals of NaCl separate on the surface during hardening.—S. Shemtschushny (Ann. Inst. Analyse physico-chim. Leningrad (Russia) 3—370-78. St. Petersburg Polytechn. Inst. and Chem. Zent. 1927, I, 2767).

Acids and Alkalis on Clay, Feldspar, Quartz and Mica

A clay sample was treated with 10 per cent HCl and afterward with 10 per cent caustic soda and the dissolved quantities of SiO_2 sesquinoxides, K_2O and Na_2O were determined and compared with the results obtained under identical conditions with quartz, feldspar and mica. The clay sample lost about 9 per cent of its weight at dark red heat, from which figure may be calculated the kaolinite content of the clay. Ten per cent HCl dissolves in 10 hours on the water bath 1.21 per cent. K_2O from a total quantity of 1.33 per cent K_2O. The dissolved K_2O is calculated as Muscovite, the undissolved as Orthoclase. The remainder must be quartz. In this manner the following composition of the clay was obtained: 71 per cent kaolinite, 10.2 per cent mica, 0.5 per cent feldspar, 18.3 per cent quartz. A Fioletowa (Keram. Rdsch. 35, 187-189).

Effect of Dilute Acid and Alkali Upon Mica

Mica which had been burned to constant weight at a dark red heat is attacked only slowly by treatment on the water bath with 2 per cent HCl followed by 5 per cent soda solutions. In two hours 26.4 per cent, in 4 hours 37 per cent, in 6 hours 47.6 per cent was decomposed. Unburned mica

(Biotite) is decomposed more rapidly; 71 per cent in six hours. As kaolinite is completely decomposed in 2-3 hours, this substance may be removed from mica by 2 per cent HCl. The mixture must previously be burned. At red heat kaolinite loses its water completely, mica only two-thirds to three quarters.

Importance of the Iron Content of Portland Cement

"Without iron no Portland Cement." Results of research to determine in what form the iron exists in Portland cement show: (1) The blue black clay actually contains ferrous oxide which is maintained in this state of oxidation due to the presence of bitumen. (2) As soon as the bitumen is completely decomposed by the air, the clay becomes yellow. (3) The yellow low burned product contains ferric oxide. (4) The gray-green clinker contains mainly ferric oxide and only a trace of the ferrous compound. Just how the ferric oxide colors the clinker gray-green has not yet been determined. In Dyckerhoff's article on "What is Portland Cement?" he determined (1) 2 $CaO.SiO_2$ fused by Knall gas has no hydraulic properties. (2) The so-called "residual" fusion made with CaO. Al_2O_3 and water at first dissolves only to a pulpy state. (3) Residual (free) lime remains as a solid solution in 2 $CaO.SiO_2$. (4) The substances 2 $CaO.SiO_2$ and $CaO.Al_2O_3$ when melted together give a clinker which lacks the strength of the usual clinkers. (5) The same substances with the addition of 3 per cent Fe_2O_3 (synthetic) give a Portland cement whose properties are entirely unobjectionable. The author believes that Portland cement does not consist of three, but of four substances; namely, CaO, SiO_2 Al_2O_3 and Fe_2O_3. Goslich (Zement, June 2, 1927, p. 446-447).

New Brazilian Cement Standards

(1) The specific gravity must be at least 3.10. (2) The residue on a sieve of 900 meshes per square centimeter must not be greater than 2 per cent. (3) By the use of the Vicat needle, the setting of the cake should begin between 1 to 3 hours and should be complete after 3 to 6 hours have elapsed. (4) A cake of pure cement of standard consistency and a diameter of 3 to 4 cm. after being cured for 24 hours in damp air is placed in cold water which is then brought to boiling. After three hours boiling, no cracks or separation should be exhibited. (5) The test made of pure cement and the exact amount of water must resist the following loads per sq. cm.: After 7 days, of which one day is in moist air and 6 days in clear water, pressure 400 kg., tension 40 kg. After 28 days of which 1 day is in damp air and 27 days in clear water, pressure 450 kg., tension 45 kg. (6) The ratio $\frac{CaO}{SiO_2 + Al_2O_3}$ should lie between 2.20 and 2.85. Maximum loss on ignition —3 per cent. SiO_2 total 20 to 25 per cent. Insoluble SiO_2 not over 1 per cent. CaO minimum of 59 per cent. Al_2O_3 and Fe_2O_3 7-12 per cent. So_3 not over 2 per cent. MgO not over 3 per cent. (7) By the use of Le Chatelier's apparatus the expansion of the test piece after 7 days should not be more than 3 mm. (8) In case it is desired to mix sand with cement the sand must be sieved on a 64-inch mesh per sq. cm. sieve. The sieved material is well washed and the residue on a 144 mesh per sq. cm. is used. The cement is mixed in the ratio of 1 part by weight of cement and 3 parts by weight of sand. Anon. (Zement, June 2, 1927, p. 447).

Fused Cement from Blast Furnace Slag

The fusible blast furnace slag is mixed with lime and melted in an electric induction furnace. It melts completely and produces an automatic circuit of the charge which is responsible for excellent mixing. If the melt is quickly cooled, as, for example, by disintegration into dust, the ground cement thus formed shows a normal setting time.—Studiengesell. f. Nutzbarm. Schweiz. Erzlag. (Swiss Patent 117,718).

Cast Articles from Volcanic Stones

Volcanic stone, blast furnace slag, or the like, is heated so that only the non-crystalline matrix and the easily fusible crystals are fused, the difficultly fusible crystals remaining to serve as crystallization centers on cooling, with the addition of other minerals not readily fusible to act as further centers if necessary. C. Krüger (British Patent 262,413).

Acid Resisting Cement

Quartz, quartzite or other acid resisting material is mixed with a colloidal solution of water glass (specific gravity 1.308-1.332) and barium hydroxide, with or without the addition of assistant or protective colloids. Schmelzbasalt A. G. & C. Trenzen (German Patent 435,913).

Cement and Other Hydraulic Mortars

In order to improve the regulation of the burning process, a kiln is used which does not necessitate the passage of the charge by heavy power, but instead a tunnel kiln through which the charge is carried at a regulated speed on small wagons. The tunnel is constructed of refractories of varying effectiveness with inlets for air, steam, etc., and is separated into three zones, in the interior of which the charge is dehydrated, causticized, sintered and cooled. Soc. Ciments Franc. etc. (French Patent 612,391).

QUARRIES STRONG IN BIG SAFETY CONTEST

WINNERS of the National Safety Competition, in which more than 250 mines and quarries in 30 states participated in 1926, were announced on June 28, by the United States Bureau of Mines, Department of Commerce. The winning mines and quarries in this nation-wide industrial safety contest, held annually under the auspices of the Bureau of Mines, are presented with the bronze trophy "Sentinels of Safety," donated by the Explosives Engineer magazine.

Notable accomplishments in the production of large mineral tonnages with no loss of time occasioned by accidents were revealed by the detailed statistical reports furnished the bureau by the competing companies. A zinc and lead mine in Kansas operated 300 days and worked 206,489 man-hours without an accident involving loss of an employee's time. A Missouri zinc mine and 14 large quarries, located in West Virginia, Pennsylvania, Alabama, Indiana, Ohio, Kansas, California, Virginia, and Michigan, also operated through the year with no loss of time due to personal injuries. The competition was one of the largest industrial safety contests ever held, and involved the tabulation of all accidents occurring during the course of 95,000,000 man-hours of labor. It required the preparation of accident statistic reports on a uniform, detailed basis which allows a more exhaustive study of the causes of accidents than has heretofore been possible. An encouraging feature of the competition was a substantial reduction in the accident rates of the winning companies in 1926, as compared with the previous year's contest.

Secretary Hoover, of the Department of Commerce, in addressing congratulatory letters to the winning mines and quarries, emphasized the importance of the American mining industry attaining world leadership in accident prevention as it has already attained such leadership in the production of mineral tonnages.

The more than 250 mines and quarries participating in the competition were divided into five groups: anthracite mines, bituminous coal mines, metal mines, mines producing non-metallic minerals, and quarries or open pit mines. A replica of the trophy is awarded to the mining operation in each group sustaining the smallest loss of time from accidents in proportion to total time worked during the year. Determination of the winners was made by a jury of award comprised of officials of various mining and quarrying associations, the National Safety Council, and the American Federation of Labor, based on a tabulation of mine accident data prepared by the Bureau of Mines. A feature of the competition is the awarding of a certificate of honor, signed by the Director of the Bureau of Mines, to every employee of each of the winning mines and quarries for their share in the low accident records made by their companies.

The winner in the anthracite group is the Highland No. 6 mine, Jeddo, Luzerne County, Pa., operated by the Jeddo-Highland Coal Company. In this group, honorable mention was accorded the Highland No. 2 anthracite mine and the Jeddo No. 7 mine, of the same company, and also located at Jeddo; to the Upper Lehigh anthracite mine, Upper Lehigh, Pa., operated by the Hazle Brook Coal Company; and to the Pine Hill mine, Minersville, Pa., operated by the Pine Hill Coal Company.

In the bituminous coal mining group, the trophy was won by the No. 6 coal mine of the United States Coal and Coke Company at Gary, MacDowell County, W. Va. Honorable mention was given to four other mines operated by this company, viz.: No. 8 and No. 7 mines, at Elbert, W. Va., and No. 5 and No. 4 mines, at Thorpe, W. Va.

In the underground metal mining group, the Muncie zinc and lead mine, operated by the Federal Mining and Smelting Company, at Baxter Springs, Cherokee County, Kansas, was adjudged the winner. Honorable mention was accorded the Velten zinc mine of the Eagle-Picher Lead Company, at Pierce City, Mo.; the Wilbur zinc and lead mine of the Commerce Mining and Royalty Company, at Treece, Kansas; the Armour No. 2 iron mine of the Inland Steel Company, at Crosby, Minn.; and the Lucky Bill lead and zinc mine ot the Federal Mining and Smelting Company, at Cardin, Okla.

In the group of underground mines producing non-metallic minerals, the trophy was awarded to the Grand Rapids gypsum mine of the Beaver Products Company, Inc., at Grand Rapids, Mich. Honorable mention was given the Ft. Dodge gypsum mine of the United States Gypsum Company, at Ft. Dodge, Ia.; the Manheim No. 5 cement rock mine of the Alpha Portland Cement Company, at Manheim, W. Va.; the Crystal City sand mine of the Pittsburgh Plate Glass Company, at Crystal City, Mo.; and the Templeton limestone mine of the Templeton Limestone Company, at Templeton, Pa.

In the quarry and open pit mine group, the trophy was awarded to the No. 5 and 6 limestone quarry of the North American Cement Corporation, at Martinsburg, W. Va. Honorable mention was accorded the following-named quarries:

West Coplay limestone quarry of the Lehigh Portland Cement Co., West Coplay, Pa.

Birmingham limestone quarry of the Lehigh Portland Cement Co., Birmingham, Ala.

Louisville cement rock quarry of the Louisville Cement Co., Speed, Indiana.

United States Gypsum Company limestone quarry, Genoa, Ohio.

Kansas Portland Cement Company limestone and shale quarry, Bonner Springs, Kansas.

Ash Grove Lime & Portland Cement Company limestone and shale quarry, Chanute, Kansas.

Mitchell limestone quarry of the Lehigh Lime Company, Mitchell, Indiana.

Cowell Portland Cement Company limestone quarry, Cowell, Calif.

No. 1 and 2 high calcium limestone quarry of the M. J. Grove Lime Company, Stephens City, Va.

Dexter Portland Cement Company cement rock quarry, Nazareth, Pa.

Royal Blue Slate Company roofing and electrical slate quarry, Slatedale, Pa.

Monroe, Michigan, limestone quarry of the France Stone Company, Monroe, Michigan.

Bellevue cement rock quarry of the Alpha Portland Cement Company, Bellevue, Mich.

Companies operating a coal mine employing 50 or more men underground, a metal or other mine employing 50 or more men underground, or a quarry or open pit mine employing 25 or more men in the pit were eligible to compete for the trophies. The trophy, which is the work of Begni del Piatta, designer of the Navy and Marine Memorial to be erected in Washington, portrays in bronze a mother and child greeting the father upon his safe return from work. The names of the mines and quarries who win the right to hold the trophy for a year will be engraved on the pedestal. On the remaining sides of the pedestal are panels emblematic of coal mining, metal mining, and quarrying and open-pit mining.

Members of the jury of award were as follows:

H. Foster Bain, secretary, American Institute of Mining and Metallurgical Engineers, New York.

James F. Callbreath, secretary, American Mining Congress, Washington, D. C.

W. H. Cameron, managing director, National Safety Council, Chicago, Ill.

H. L. Gandy, secretary, National Coal Association, Washington, D. C.

A. T. Goldbeck, director, engineering bureau, National Crushed Stone Association, Washington, D. C.

William Green, president, American Federation of Labor, Washington, D. C.

A. J. R. Curtis, assistant to general manager, Portland Cement Association, Chicago, Ill.

The following congratulatory letter was addressed by Secretary Hoover to the winner in each group:

"The excellent safety record established by your company at one of its plants during the year 1926, as shown by the results of the National Safety Competition held under the auspices of the Bureau of Mines, is a matter for congratulation to your company and of encouragement to all persons interested in safety in the mineral industry. It is such work as is being done by your company and others that affords the best hope that the United States may lead the world in mine safety as it is already leading in mineral production. Our aim should be for progressively lower accident rates.

"The success of your efforts in safety work during the past year entitles your company to receive the 'Sentinels of Safety' trophy which is awarded to the leaders in the National Safety Competition. Also, since the prevention of accidents is dependent not only on the operators that produce our coal, iron, stone, and other minerals, but also on each employee of the mine or quarry, the Bureau of Mines will issue a Certificate of Honor to each man employed by your company in 1926 at the plant whose safety record is recognized by the award of the trophy."

How to Minimize Truck Costs

Almost every branch of industry now uses motor trucks as an auxiliary to their transportation system. Even the comparatively small plants have at least one or two trucks, and these are usually in service every day, bringing raw materials and parts to the plants, or shipping finished products. Efficient management always extends to the operation of these trucks.

Successful bonus plans designed to encourage proper handling and maintenance of trucks by drivers have been devised, the principles of which can be applied, readily and frequently profitable, to unrelated plants. One company, for instance, has two simple plans in effect, the results from which have been excellent. One of these plans is to offer each truck driver $2.00 for each 1,000 miles he runs his truck over the tire maker's guaranteed mileage for the front tires and $5 per thousand miles over the guarantee for the large rear tires. This plan has thus far resulted to the mutual satisfaction of both driver and owners.

When trucks are handled to deliver more mileage on tires, it has been found that other benefits accrue. The engine requires less attention, and the differential and other wearing parts will stand up for a longer period. Overloading of the truck and speeding are practically eliminated, yet records show that hauling production has actually increased.

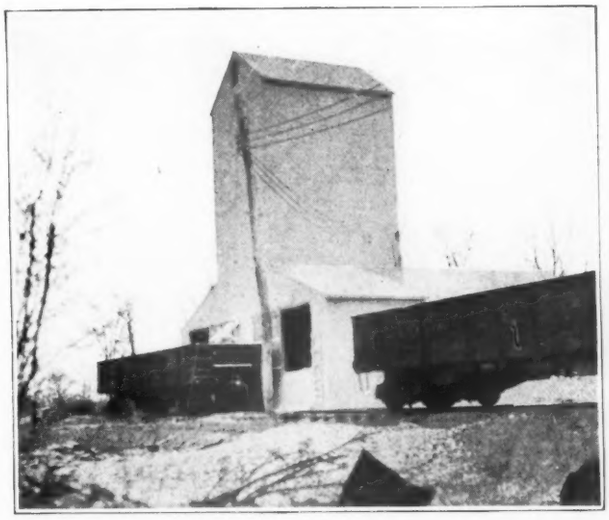
A second bonus plan applies to the springs. Each driver receives $2 for every three month period in which no springs on his truck are broken. This has been found a profitable investment, since hundreds of dollars are saved yearly through the careful driving of the men. Repair bills are greatly reduced and continuous service again contributes to increased tonnage-miles.

Another company has a pooled no-accident bonus for the drivers and helpers.

DONALD U. SMITH STUDIES PEAK LOAD IN DETERMINING PLANT UNITS

By George Ransom

INSTALLATION of sufficient machinery to care for the peak load of a plant is a problem which usually leads to either financial success or failure and cannot be given too careful consideration. Different operators solve this problem in various ways depending on the character of their output and the local conditions under which their production must be carried on. Under certain conditions it is efficient to have small units in separate buildings. This gives flexibility where a variety of products are made, as in this case any desired unit may be shut down, all may run on the production of the same article or they may all be used for different materials. This method works well with marble chips for terrazzo and stucco, which have agricultural lime as a by-product, and is the plan followed by Donald U. Smith, of Ashley Falls, Massachusetts, who has recently added a new unit to his plant.

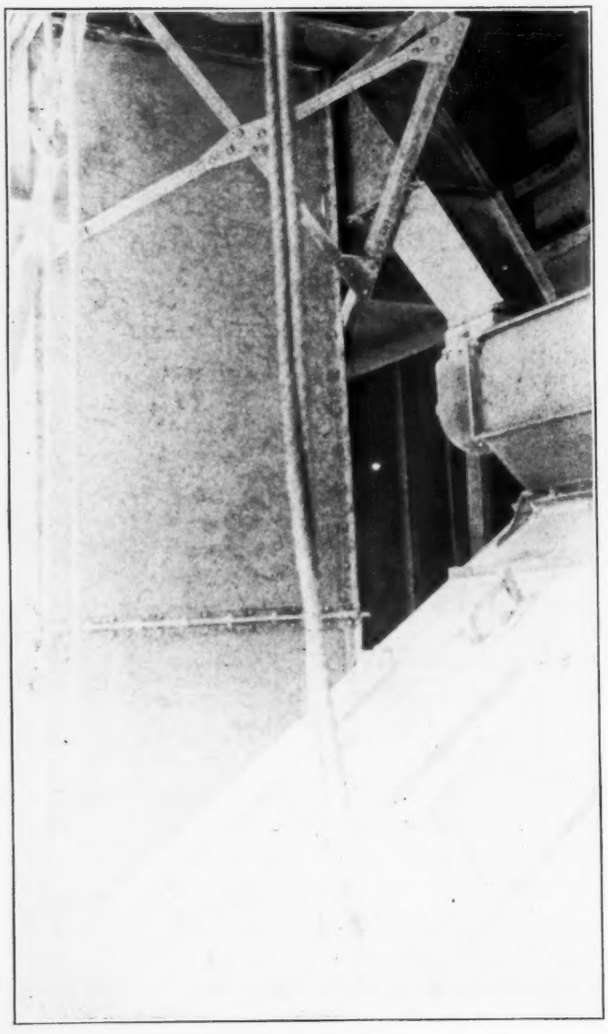


Outside View of the New Plant Showing Railroad Siding

Formerly there were two units—an up-to-date Sturtevant installation and an old crushing plant which was not entirely satisfactory. These two units were described in a previous issue of Pit and Quarry. The old unit has recently been dismantled and some of the equipment moved to a new building which, with the addition of a considerable amount of new machinery, has been made into a very efficient and flexible new unit. This work was also done by the Sturtevant Mill Company of Boston.

The immediate reason for the erection of this new plant was to care for the output of a calcite marble quarry purchased in the town of Sheffield, Massachusetts, about six miles from Ashley Falls. The marble at Ashley Falls is dolomite. The crushing capacity of the company has thus been doubled, though the capacity of both crushing plants was

The Two Unit Plants. The Newest is that at the Extreme Right



Elevator and Chute to Vibrating Screen

sold out, for the season, by May of the present year from the old dolomite quarry.

Let us consider the mechanical equipment of the new unit, which is extremely interesting because it has a capacity of 125 tons per day and is operated by only one man. Stone from the quarry is dumped from cars into a 10x16 inch Farrel primary jaw crusher from which it is taken by an inclined Sturtevant elevator, 27 ft. 7 in. between centers, to a Sturtevant number 2 open door, rotary crusher. The material is next taken in a Sturtevant steel encased elevator, with 8x5 inch buckets spaced 16 inches apart, in a combination elevator chain, to a Sturtevant 2 unit conveyor feed Moto-Vibro screen, placed near the top of the building. This screen may be equipped with either two or three screening surfaces and various sizes of mesh may also be used to produce different products which are required. If equipped with two screening surfaces, the screen produces an oversize product, an intermediate product and a fine product. If equipped with three screening surfaces, two intermediate products are produced, in addition to the oversize and the fines. If equipped with three screening surfaces, the distribution of the material after passing through the screen is as follows: The oversize passes into a hopper underneath the screen, at the bottom of which is placed a dividing valve. This dividing valve permits the oversize to be distributed either to the rotary crusher, or to 12x24 inch Traylor rolls for re-crushing, or allows a part of the oversize to go to each of the two machines. The coarse intermediate product passes through a chute to a bagging hopper, and the fine

Portable Belt Loader Outside of the New Plant

intermediate product passes through another chute to another bagging hopper. It is also possible to blend the two coarse intermediate products, and send them to a small bin, or to divert them to the rolls for recrushing. The bin capacity is not large, as Mr. Smith desires to load the material in cars practically as fast as made. The fine products from the screen go to a bagging hopper.

If used as a two screen machine, producing three products, the oversize material can be sent to either the rotary crusher or the rolls, or part of this product to each of the two machines. The intermediate product can be sent to the bin, the rolls, or can be bagged, and the fine product is bagged exactly as in the former case.

By selling out the capacity of the plants so far ahead it is not meant, in the present instance at least, that both of the plants are scheduled to run full production for the whole season. The fact is realized that during the latter part of the summer there will be a heavy demand for materials from regular customers. In other words the peak load will occur at that time, partly as a result of the hand to mouth buying which is so prevalent at the present time, and if this company cannot serve its customers they will go elsewhere and their business will be lost. Thus orders taken early in the season are held down to a point which will leave sufficient spare capacity for the peak. This system calls for some rather careful calculating but it must be done in order to render service to customers which is essential to success, and Mr. Smith and his brother realize this condition very clearly and act accordingly in their business.

A hopper is provided into which any size can be diverted for the bulk loading of cars or from which material may be returned to the rotary crusher, roller crusher, the bin previously mentioned or to the bagging spouts. It is apparent that the flexibility of arrangement for sending stone in various directions by means of chutes is unusually well planned. There are no storage spaces, properly so-called, for anything except for agricultural lime, which has a seasonable demand and accumulates as a by-product during the manufacture of the main product and therefore must be stored.

One of the very interesting and practical details of this mill is the centralization of the motor control equipment. All of this is segregated in a separate room on the ground level adjacent to the primary crusher. There are no controls at the motors because one man runs the entire plant and he is stationed at the primary crusher. There are five Wagner squirrel cage induction motors used to operate this new unit as follows: one for the jaw crusher and inclined elevator, one for the rotary crusher, one drives the rolls, another operates the inclosed elevator and the other the vibrating screen. Allen-Bradley boxes are used to start up the several machines. Another recently acquired piece of equipment is a Barber-Greene portable loader which is used chiefly for handling quarry waste. This machine is proving a great labor saver because a large area can be covered without moving the tracks or handling the waste more than once.

Next Sand and Gravel Convention Will Be Held in Detroit

The Board of Directors of the National Sand and Gravel Convention met in Chicago on June 28 and 29, at the Palmer House. At the executive session on June 28, Detroit was selected for the next annual convention on January 4, 5 and 6. The sessions will be held at the Book-Cadillac Hotel.

The financial report presented showed a strong position with a substantial bank balance. It was decided to install a completely equipped laboratory in Washington, at the Association headquarters, for research work under the direction of Stanton Walker.

The Gravel Ballast Committee held a meeting and decided to approve the specification of the American Railway Engineers Association but with the suggestion that one general classification be used in place of the present three divisions of classification of gravel ballast.

Mr. McGrath of the McGrath Sand and Gravel Company spoke at the luncheon on Wednesday. He explained how he wrote a letter to the presidents of several railroads in the midwest territory asking them to discourage the building of new plants in view of the present excess of productive capacity in Illinois. Favorable replies were received to these letters and a powerful means of discouraging the building of new plants is expected to function for the good of general business in Illinois.

Messrs. Warren, McMillan and Hart of the Portland Cement Association were among the guests present. These representatives endorsed the research work of the National Sand and Gravel Association and volunteered the cooperation of the Portland Cement Association.

The Committee on Specifications for Standardized Sizes of Sand and Gravel met on June 29 and elected two new members, R. J. Potts and Earl Zimmerman. The committee discussed the commercial sizes of sand and gravel but did not take any definite action.

The road program of the Province of Quebec for this year provides for the construction of the balance of the main truck highway system totalling about 230 miles; 400 miles of county and local roads; permanent resurfacing of 125 miles of Provincial and regional highways and 25 miles of county and local road improvements. The budget for the present year amounts to $6,500,000.

Cost of Labor Turnover

The needless waste of human effort and money ontailed in the hiring, training and firing of employees who do not yield a satisfactory return on their investment is appalling in its magnitude. Recent estimates place the economic loss due to labor turnover in the United States at 1½ billion dollars annually. In making this estimate the economists took into consideration the six principal factors contributory to labor turnover expense, which are: 1—Clerical cost of hiring and firing; 2—breaking in, or instructing new men; 3—decreased production of new employees until proficient; 4—spoilage of materials and damage to machinery and equipment; 5—cost of idle machinery and unused equipment, due to delay or improper operation; 6—increased accidents.

In this investigation, which was carried on at the instance of several large organizations and associations, and which was conducted by earnest and unbiased research devotees, it was found that in the shoe industry it cost $576 to train an unexperienced man for the work of cutting upper leathers; for a semi-experienced man, $450. It cost $300 to train an apprentice to deliver normal production on outersole cutting, while the costs for installing skilled workers who required no training, but merely acquaintance with new surroundings, never fell below $50.

In a large rubber company it was found that to hire and train a new employee in the tire department, four weeks time and an investment of $150 was necessary. In the rubber boot department fifteen weeks training and $190 were required on the average, while a tennis shoe worker cost $100 and eight weeks to train. However, in this instance, no calculations were made covering spoilage, or idle machine time.

Replacement costs for workers depends largely upon the nature of the work and the degree of specialized knowledge demanded by the job. In machinery shops costs were found to range from $50 to $100 per worker; in automobile plants, an average of $78; in certain departments of a paper mill, $100 to $125; for railway motormen, $200 to $250; and for sheet metal work, from $75 to $90.

From an analysis of the estimates obtained in many plants throughout the country it was found that the average replacement cost per worker in general industry slightly exceeded $50. Labor turnover is seen, therefore, to be a very expensive item in direct overhead, and its consideration to other payroll losses should never be overlooked. Labor turnover effects far more than the mere showing on the cost sheet. The production manager feels it, since a constant stream of new men will seriously impair production schedules. The inspection department feels it through the necessity to return an increased number of defective pieces. The sales department is effected sometimes, through the unconscious lowering of quality standards. Plant or organization spirit, furthermore, is seriously effected with the result that labor difficulties are more frequently encountered.

The whole subject of labor turnover requires careful study. Employee selection, supervision, prevailing working conditions, producer incentives, existing wage levels, vocational guidance and constructive education in production methods and costs, are all factors. Cooperative management schemes of various types of "industrial democracy" seldom offer more than illusionary, and temporary, relief. The introduction of cooperative scheme naturally call for more or less sterotyped methods and procedures. This single requirement should turn the thinking executive away from their adoption since even superficial thought will prove that each plant has its own individual problems and must have its individual remedies. Labor turnover is an individual plant problem for individual plant executives, and when properly considered in this light, corrective measures will reveal themselves.

The Basis for Wage Calculation

Considering, for the purpose of comparison, that the existing wage level in the Philadelphia district is the basic "100," we find the existing wage level in Ottawa to be 83, that the wage level in Copenhagen is 72, in London 56, Stockholm 49, Berlin 40, Brussels 33, Paris 33, Vienna 29, Milan 28, Warsaw 26, Yokohama 24, Shanghai 20, and Singapore 18.

There are several reasons why wages should be so high in the United States, the foremost of which is the enormity of our natural resources. Another contributing factor is the magnitude of the area over which we are afforded freedom of trade. Ethical business standards that make possible the protection of property, operation of large industrial units, and the accumulation of capital is still another factor that contributes to the elevation of our wage level. A fourth reason can be found in the universal adoption of labor-saving, labor-aiding, and production-increasing machinery and organizations. Evidence of the influence of machinery on the economic status of the nation is contained in the fact that while the United States represents only a scant 6 per cent of the world's population, we produce 64 per cent of the world's petroleum and use 72 per cent; we produce 49 per cent of the world's copper and use 44 per cent; we produce 69 per cent of the cotton and consume 37 per cent; 41 per cent of the shoes and consume 39 per cent; 43 per cent of the coal and use 42 per cent; 64 per cent of the steel and use 57 per cent; 54 per cent of the iron and use 53 per cent. Thus is shown the efficiency and speed of American labor and indus-

try. Because production is so high, wages are high, for every economic law makes wages dependent upon production—labor leaders to the contrary notwithstanding.

Operating simultaneously with the factors that make for increased wealth and higher wage levels, are influences that tend to depress wages. The majority of this depression comes in the form of production limitation. Anything that tends to reduce production, be it a flood in the Mississippi Valley, or a labor union that reduces the per-man-output, depresses wages. Every workman should grasp that fact. Just the moment complete recognition has been given that basic truth, intelligent cooperation on the part of labor, capital and management will be substituted for class struggles, strikes, and industrial conflicts, as a means for advancing wages.

Another great influence for the depression of wages is industrial waste. This may come in the form of wastage of power, light, fuel, or water; or it may come from wastage due to stupidity, carelessness, lack of training or improper supervision. All such wastage depresses wages because it limits production.

Dishonesty is an important factor in the depression of wages. Every payroll robbery is, in effect, an attack not only on the individual company but on the general wage level of all industry. Fradulent bankrupts and fake stock venders are parasites that subsist on the blood of producers and thereby tend to limit production and depress wages. All such influences impose a burden on industry, and since industry is composed of both employers and employees, both must share the load.

Every right thinking employer wants to see and contribute to good working conditions and proper wages. "Proper" wages are not "living wages" not yet "saving wages" but—producing wages. The amount any employer can pay out in wages depends entirely upon the amount of labor produced. The foundation principle of wage payment is that no employer can pay more for work than the total added value of such work.

Cost of Absenteeism

Employees who are absent or tardy constitute an expensive item to employers. In fact, the industrial losses caused by absenteeism in the course of a year are far greater than is commonly supposed. Investigations into the extent of absenteeism for the entire nation show that the average amount is 7 per cent of the worker's time, or about 21 days per year of 300 working days. Assuming even the low average of $4 per day, this yearly loss for our 40,000,000 wage earners totals a sum staggering to the imagination. Needless to say, the employer's share of this loss is a substantial proportion.

Some of the major items that must be considered as a result of excessive absenteeism or tardiness are:

1. Maintenance of a larger payroll.
2. Idleness of machinery or equipment.
3. Increased accounting costs due to irregularities.
4. Impairment of discipline and control.
5. Interruption of planned schedules and production layouts.

Plans for rewarding steady attendance and punctuality usually produce better results than the negative plan of "docking" for lost time. Both plans are in use at the present time, but industrial relations experts who have made a study of the problem report that a far greater percentage of the "reward" plans are functioning satisfactorily than are the "docking" plans.

The payment of bonuses as a means for encouraging attendance and promptness is practiced, with varying degrees of success (usually high, however) by a number of institutions. As an instance, one plant pays a 2 per cent bonus on every semi-monthly pay day to all employees whose record for attendance and punctuality was perfect for this period. Another pays a bonus of $2 a week to its female workers for perfect attendance. In still other cases, the bonus varies from monthly theater tickets to 10 per cent of the established salary.

In addition to providing either positive or negative incentives to improve attendance, the causes of absences or tardiness must be seriously considered if the trouble is to be materially reduced. Prompt investigation of all cases is considered adviseable in many instances. A few organizations, for example, send out service workers in a plant automobile to check up on each case, they being required to visit the homes of the absentees and report the details of each case. Others use the telephone as a check-up on the seriousness of the trouble. One plant requires the absentee to report, upon return, to the company physician before he can go to work. This practice is perhaps the most simple and more effective in eliminating fictitious ailments and excuses for absences.

Absenteeism is a serious problem to solve, since many factors enter into it for consideration, such as ventilation, light, sanitation, noise, working conditions, and other causes that create illness, undue fatigue, or disinterest. That the problem is sufficiently large in importance to justify the attention of every management is seen by the fact that the average workman is absent 21 days a year.

Building operations at the principal cities during May, as indicated by new permits issued, totaled 281 million dollars compared with 306 million dollars for the same cities in May of last year.

Unusual Sand and Gravel Unit for New York

A large proportion of the sand, gravel and limestone used in highway construction in the vicinity of Oaks Corners, Ontario County, New York, comes from the pits and quarries located there. Near the end of the eighteenth century Thaddeus Oaks, who came up from Conway, Massachusetts, purchased a large tract of land from the Phelps and Gorham purchase, and about the center of the tract the village of Oaks Corners sprang up. Although its population has not grown to large proportions, it has become the site of a considerable industry in the production of road material. Of the original purchase abuot 800 acres are still in possession of the Oaks family, no transfer deeds being on record since 1798. The present owner is Nathan Oaks, who lives in the little hamlet in a house built by an uncle 80 years ago. Under the firm name of Nathan Oaks & Sons he conducts a large farm, a fine dairy, an extensive chicken range and the best equipped sand and gravel pit in Central New York.

About four years ago Mr. Oaks found on his farm a substratum, about 18 inches below the surface, of sand and gravel conforming to the demands of road builders, and he installed power shovels, derricks, and belt conveyors to bring the material up to road level. As the excavation deepened a pool of water formed in the pit, and as the level of this pool remained continuous for several months, neither rising nor falling, this presented a new method of removing the material. Gradually a complete hydraulic system was installed, operating from a barge in the pit. The deposit was found to be uniformly 30 feet deep, the water remaining at a level of 15 feet.

A 6-inch centrifugal pump, operated by a 75-horsepower motor, draws the material through a 6-inch pipe whose outer edge presses against the bank near the bottom of the pit, undercutting the deposit. This cause the material to cave in so that the elevation of the suction pipe seldom has to be changed. A flexible pipe line about 500 feet long, composed of lengths of 6-inch pipe connected with rubber hose and carried on a series of pontoons, follows the pumping equipment and carries the material to the separating plant. The separating and grading is done largely by gravity, the stream of water and material being discharged into a revolving inclined screen with 5/8-inch and 1/2-inch openings. Material passing the screen is washed down two inclines to shallow slightly inclined pans, the water and dirt passing off as more and more water falls into the settling basins. It is then conveyed to an elevator that carries it to the loading bins. The whole pit equipment is so simple and so nearly automatic that only two men are required for its operations.

The Oaks plant is the only one in New York State where the water is naturally contained in the pit and where it actually assists in the removal of material. Another unusual condition existing at Oaks Corners is that not only sand and gravel, but stone also, is available there for road building, a quarry being operated there by the General Crushed Stone Company, whose headquarters are at Easton, Pennsylvania, but which conducts fourteen crushing plants in various parts of the country. The quarry at Oaks Corners consists of an enormous ledge of limestone.

New Incorporations

Oregon Lime Products Co., 1038 Northwestern Bank Bldg., Portland, Ore. Directors T. B. Neuhausen, A. A. Muck, Emily A. Muck, Arthur I. Moulton. A. A. Muck, Pres.; E. A. Muck, V. P.; Arthur I. Moulton, Sec.; T. B. Neuhausen, Treas. $100,000.

Jerome Sand & Gravel Corp., N. M. Pette, Jamaica, N. Y. $25,000.

Seguin-Jersey Sand Co., Kenvil, N. J. $125.000. Henry A. Hurlburt, Clarence A. Plume, Succasunna William M. Seguin, Kenvil.

Dalles Crushed Rock Co., Dallas, Ore. $5,000. Walter W. Hart, Fred F. Thompson, W. J. Seufert.

New Jersey Sand & Gravel Co., Spring Lake, N. J. $1,250,000. Bought property of Bennett Gravel Co., Wall Sand & Gravel Co., and Hause Washed Gravel and Sand Co. J. Claud English, Pres.; David Newman, V. P.; Elmer H. Geran, Sec.; Russell Yawger, Treas.

Alexander Thomson & Son, Marble, 1002 Bank of Manhattan Bldg., Bridge Plaza, Long Island City, N. Y.

Capital City Sand & Gravel Co., Tallahassee, Fla. $200,000. H. D. Trawick, C. A. Goldsmith.

Wells Marble & Granite Co., Fort Worth, Tex. $10,000. Anna B. Wells, W. C. Wells, Oscar H. Cheek.

Crystal Sand Co., Mission, Tex. E. A. Showers, J. D. Brock, Dallas.

Ripton Crushed Stone Corp., Rochester, N. Y. 250 shares com. (Warren Schuster & Case, Rochester).

Diamond Gravel & Lumber Co., Murfreesboro, Ark. $50,000. To operate gravel pits. John A. Davis, Pres. Hartwell Greeson, V. P.; Frank Stroupe, Sec.; W. G. Stainton, Treas.

Quincy Sand & Gravel Co., Quincy, Mass. $100,000.

Olympian Stone Co., Seattle, Wash. $10,000. Lee Swartz, S. C. Kinghorn.

Oregon White Lime Co., Clackamas, Ore. $50,000. Richard Turpin, J. Frank Turpin, Lulu M. Turpin.

Commonwealth Cement & Stone Co., Mentor, O. 500 shares n.p.v. Frank J. Peterson, H. L. Parmenter, L. I. Schiffman.

Do the Sheaves Fit the Rope?

There is perhaps no single element that can be more detrimental to wire rope than an improperly fitted sheave. A pinching sheave actually will do more damage to a wire rope in 60 minutes of operation than a properly grooved sheave could do in an entire week. Or, a sheave with too soft a tread will increase abrasion and grinding action to an extent that will cause premature breaking of the outer wires and loss of rope strength. Because of these facts and because sheaves are cheaper than good wire rope, it may be well to look to the sheave and auxiliary equipment if it is felt that the life and service being received from present rope is not all that it should be.

Engineers and operators sometimes overlook the fact that by the time it becomes necessary to install a new rope the old sheave will have become worn to such a degree that it will cause serious damage to the new rope. Invariably excessive wear to the outer wires can be traced to the abrasive action of worn or too soft sheave treads.

When installing a new rope, therefore, it is economy to gauge both the rope and the grooves of all sheaves and drums. If the groove diameter of any sheave is less than the actual callipered rope diameter, then sheave replacement should be made—or decreased rope service will result.

One of the simplest and most accurate methods for gauging sheave treads is through the use of a groove guage, which, if used with care, and in accordance with the tolerances given in the table below, will assure longer and more satisfactory rope service. While guaging is being done, attention also should be paid to alignment. Misalignment will cause considerable wear to both rope and sheaves. Particularly in high-speed work is it necessary to maintain proper alignment of all equipment and to balance all sheaves.

Rope Diameter	Tolerance of Groove Diameter
1/2 inch and smaller	Plus 1/32 inch to plus 3/32 inch
9/16 inch to 1 inch	Plus 1/16 inch to plus 1/8 inch
1 1/16 inches to 2 inches	Plus 3/32 inch to plus 3/32 inch
Over 2 inches	Plus 1/8 inch to plus 1/4 inch

INTIMATE NEWS OF MEN AND PLANTS

Veteran Cement Man Retires

From Trident, Montana, comes the report of the retirement of Elvin U. Leh, general superintendent of the Three Forks Portland Cement Company's Montana plants, who submitted his resignation after ten years' successful service in that state. Mr. Leh's connection with the cement industry covers a period of 40 years, making him practically a pioneer in this business, which was only in its infancy when he first entered it in Pennsylvania. Since that time he has constructed and managed plants in various parts of the United States and Canada, coming to Montana from California in the fall of 1917.

Mr. Leh was twice elected president of the Associated Industries of Montana and devoted considerable time and effort to the up-building and stabilizing of the industries of the Treasure state. He expects to sever all his connections with the cement business and devote his entire time to his interests in California. Clarke F. Leh, mechanical and construction engineer, who has also had wide experience in the cement industry has been named successor to his father and will assume his duties as superintendent at Trident.

Big Gravel Deposit Opened at San Diego, California

What is said to be the finest and largest single gravel and sand deposit in San Diego County, California, has recently been acquired by purchase and lease by the Spreckles Commercial Company and work has been started on the construction of a crushing plant, which, according to an announcement made by Mr. Claus Spreckles, will be ready for operation about August 1. The deposit lies in the Otay River bottom and stretches from a point just below the lower Otay dam for six miles down the river bed, averaging 10 feet deep and 500 feet wide for the whole six miles.

According to George A. Roalfe of Long Beach, consulting engineer who inspected the properties for Mr. Spreckles, the gravel and sand in the deposit is sufficient to care for the construction needs of San Diego for the next 100 years. The properties on which the deposits are located amount to some 3,000 acres, more than half of which are owned by the Spreckels Commercial Company.

Of especial importance is the fact that the sand and gravel is of unusually high quality. The sand is very coarse and contains a minimum of silt and earth and practically no mica. The gravel rock is of the same high quality, lending itself well to both economical working in the plant and to the highest uses in construction. The estimates of the quality and quantity were made by Mr. Roalfe, who is the consultant for the Graham Rock Company, which is the Wrigley concern getting its crushed rock from Cataline Island. The firm of Watson, Valle & Gough represent Mr. Roalfe in San Diego in making the surveys of the properties and the gravel beds, and locating the plant and supply lines.

The plant will be located at the lower end of the deposit, about 12 miles from San Diego. It will represent an investment of approximately $150,000 and will produce 1,000 tons per day, with the possibility of being enlarged to a capacity of 2,000 tons. A fleet of six-wheel 10-ton trucks, about 30 of them, will probably be used to haul the sand and gravel from the Otay valley into San Diego.

Ideal Sand and Gravel Operates Modern Plant

The plant of the Ideal Sand and Gravel Company is located on the Chicago, Milwaukee and St. Paul Railway about two miles northeast of Mason City, Iowa. Two 2½-yard all steel drag line excavators and a 2-yard drag line excavator are used to remove the deposit from the pit. The material is conveyed from the excavator pile to the hopper in the plant by fifteen standard gauge dump cars. Two 40-ton standard gauge locomotives and a 20-ton standard gauge locomative are in service at the plant. A 20-ton standard gauge locomotive crane is also in service by this company. There are also approximately six miles of standard gauge track.

The crushing and screening plants are equipped with modern machinery and have a capacity of fifty cars of washed and screened material in ten hours. For washing approximately 2,600 gallons of water is used per minute. All machinery such as pumps, screens, conveyors, etc., is driven by electric motors. The plant operates its own modern equipped repair shop and also carries parts in a stock room for replacement of its machinery. Five grades of gravel and three grades of sand are produced and provision is made for from fifty to seventy-five thousand tons in storage. All this material will pass the Highway and Architect specifications. The plant makes shipments during the entire year.

New Corporation Acquires Sand and Gravel Plants

From Red Bank, New Jersey, comes the report that the New Jersey Sand and Gravel Company, recently incorporated with capital stock of $1,250,000, has taken over the properties of the Bennett Gravel Company, the Wall Sand and Gravel Company and the Hause Washed Sand and Gravel Company, all located in Wall township. The officers of the new company are J. Claude English, president; David Newman, vice-president; Elmer H. Geran, secretary, and Russell Yawger, treasurer. The directors besides the officers are F. F. Shock, Charles Lawrence, T. A. Miller, F. W. Hause, Edwin R. Conover and State Comptroller Newton K. Bugbee.

Louisiana Cement Plant Now in Operation

A report from New Orleans announces the starting of operations at the new plant, recently completed, of the Louisiana Portland Cement Company, located on the Industrial Canal in that city. The limestone used is shipped on barges from quarries at St. Stephens, Alabama, and the company will use its own tug and a fleet of barges. A. D. Stancliff, superintendent, A. C. Harragin, secretary and treasurer, and other officials witnessed the unloading of the first material. About 600 tons of limestone and 200 tons of clay silt will be used daily to make approximately 2200 barrels of cement.

Reported Cement Merger Off

We have been advised of an announcement by officials of the International Cement Corporation and the Lehigh Portland Cement Company that recent negotiations looking toward a merger of the two properties have been discontinued.

Davenport, Iowa, entered the list of cement-producing centers last month when the Dewey Portland Cement Company turned out its first product at the new plant west of that city.

Universal Launches Freighter With Ceremony

On June 25th the million-dollar 12,000-ton freighter, "B. F. Affleck," one of the largest boats in the Pittsburgh Steamship company's fleet of 90 vessels, marked another notch in the career of a man who left school at the eighth grade, entered a machine shop at 13, studied nights and rose to an outstanding figure in industry with a lake leviathan named for him.

B. F. Affleck

Mrs. B. F. Affleck

A. R. Kuhlman, president Toledo Chamber of Commerce, Horace S. Wilkinson, chairman of the Board of Directors of the Crucible Steel Company of America, director National City Bank, N. Y., president Great Lakes Transportation company and president of the Toledo Shipbuilding company which built the vessel; A. F. Harvey, president of the Pittsburgh Steamship company which owns the boat and operates the largest fleet of freighters on the Great Lakes, and other notables took part in the ceremonies. Interest in the event was increased by the official christening by Mrs. B. F. Affleck of the new freighter named for her husband who is president of the Universal Portland Cement company and former president of the Portland Cement Association.

To build the "B. F. Affleck" required among other things, 4,500 tons of steel, 785,000 rivets and 11 tons of paint. From top of pilot house to keel the craft measures 65 feet. J. F. Rawlinson, general superintendent of the company which built the boat, and his father, formerly were builders of battleships in English ship yards. Launching this huge new freighter which will carry coal, iron ore and limestone on the Great Lakes, completes another link in the large deep-water program of the cement company, a feature of which was the formal opening recently by Vice-president Charles G. Dawes of the cement company's new Buffington harbor, the first harbor to be built on Lake Michigan in twenty years and one of only three such harbors on all the lakes, the others being at Gary, Indiana, and at Calcite, Michigan.

The "B. F. Affleck" Freighter

Chicagoans Purchase Quarry

J. P. Casey and J. H. Marquard, both of Chicago, have purchased the Thompson stone quarry located on the Fox and Illinois Union Line at Central They have ordered the erection of a 500-ton crushing plant and will begin operations as soon as the new equipment is ready.

A 750,000 Ton Blast

According to a report from Bakersfield, California, the entire face of a mountain of limestone near the town of Monolith in Tehachapi Valley was lifted into the air and dropped in a 750,000 ton heap, by the Monolith Portland Cement Company. It was done at one blast, 180,000 pounds of explosive being used.

Huron Portland to Launch New Self Unloader

The new steel steamer "S. T. Crapo" will be launched at the Great Lakes Shipbuilding yards at 12:00 o'clock noon, eastern standard time, Thursday, July 7, 1927. The "Crapo" will join the Huron Company's fleet, the steamers "John W. Boardman" and "Samuel Mitchell." These steamers are modern, self-unloading, bulk cement carriers on the Great Lakes, exclusively engaged in carrying Huron Portland Cement for the Company's various plants at Alpena, Detroit, Wyandotte, Cleveland, Milwaukee, Buffalo and Duluth. For the launching of the boat an exclusive charter of the steamer "Wauketa" has been made to conduct the launching party from Detroit to the Great Lakes Shipbuilding yards at Ecorse on the Detroit River, thence to the Cement Company's private dock at Wyandotte for a brief inspection of its new Wyandotte plant and return to Detroit.

Texas May Build Its Own Cement Plant

According to a report from Austin, Texas, the State Senate has adopted a resolution introduced by Senator Walter C. Woodward of Coleman requesting the State Board of Control and the Highway Commission to submit to the legislature an estimate of the probable cost of constructing and equipping a state plant to manufacture cement for use in road construction. Senator Woodward, in his resolution, expresses the opinion that, in view of the extensive road program being carried out by the Highway Department and the fact that labor furnished by the State penitentiary can be employed in the operation of the plant, a state-owned plant would save the state and counties much money in road construction.

Union Rock Company Purchase New Property

At a recent sales meeting held at the Jonathan Club, Los Angeles, California, George A. Rogers, president of the Union Rock Company, Los Angeles, California, announced the purchase of the properties of the Orange County Rock Company, the Yaeger Rock Company, and the Kavanagh & Twohy Rock Company, all situated near the city of Orange, in Orange County. The purchase price was half a million dollars, and with the contemplated improvements and enlargements of these plants, the total investment of the company in Orange County, will be in excess of one million dollars.

Mr. Rogers says: "We are adding these three units to our ownership, in line with our general policy of being prepared to give direct service, either retail or wholesale, to all parts of Southern California. Hitherto, we have never been directly interested in plants or distributing stations in Orange County, but we are now prepared to give this important section adequate service at all times, even under maximum demand.

"The Orange County Rock plant is situated on the Southern Pacific Railroad at McPherson, and has a production capacity of approximately 2000 tons per day, and will be available for both carload and truck shipments. The Yaeger Rock plant is situated about three miles south of McPherson, and has a capacity of about 1800 tons per day, and will be used exclusively for truckload deliveries. The Kavanagh & Twohy plant is situated about two miles south of McPherson on the Southern Pacific Railroad and will be available for both carload and truck shipments. This combination, under one management, assures Orange County of adequate service, under maximum demand, as well as uniformity of material. In line with our general policy, the company proposes to market only the most carefully prepared materials, and to carefully wash all sand, which we have found to be safer for the important construction activities of Southern California, and indeed has been found by authorities all over the United States, to be the only safe method to procure uniformity in this important commodity. Washed plaster sand, by the way, has recently been introduced by the Union Rock Company, and has been meeting with great success, and this commodity will be manufactured by us in Orange County. It is proposed to operate all three of these units, as the demand requires, and no curtailment in employment of local labor is expected to follow the purchase. In line with the Company's policy in other communities where we have been operating, we expect to take a keen interest in everything affecting the welfare and growth of the city of Orange and Orange County."

Kyrock Business Increases Sixty Per Cent

Kyrock sales and shipments for the first five months of this year show a sixty per cent increase over the record year of 1926, according to report from Mr. Holly Burch, superintendent of the storage and shipping yards of the Kentucky Rock Asphalt Company at Bowling Green, Kentucky. Last year this company shipped into thirty-two states and two foreign countries a tonnage equivalent to five million square yards of paving surface. The plant at Kyrock, Kentucky, has a crushing capacity of 2,500 tons per day. It operates the year around. Production during the winter months is concentrated in storage at Rockport and Bowling Green, Kentucky, to insure prompt shipment during the road building season. At the beginning of the construction season Mr. Burch reports that he will frequently have as much as one hundred thousand tons of Kyrock in storage at the Bowling Green yards. The storage pile is completely underlaid with standard gauge track.

Left to right: Horace V. Goodrich, Assistant Treasurer; Larence L. Rogers, Vice-President; M. McIntyre, Service Manager; Robert E. Rogers, Secretary; W. J. Van Valkenburgh, Sales Manager; George A. Rogers, President; Robert Mitchell, Assistant Secretary; Leon Rosenbaum, Credit Manager; Thomas C. Rogers, Treasurer.

New Arkansas Cement Plant Going Ahead

According to a report from Foreman, Ark., the first steps toward the erection of the cement plant for the American Portland Cement Company were taken early this month when the Frisco Railroad started grading for the switch track which will lead from the main line to the site selected for the plant. C. E. Oxford, representing the American Portland Cement Company, is on the ground and has established a local office. Col. Hunt and other engineers of the Hunt Engineering Company of Kansas City, have also arrived on business in connection with construction of the plant.

New California Cement Plant

According to a report from Ventura, California, a cement plant to cost $1,000,000 is being planned for the Matilija Canyon section, in Ventura County. In connection with this project, Edward Duryee, president of the White Crown Products Company of Los Angeles, has written to the Board of Supervisors of Ventura County, asking for certain concessions. In his letter Mr. Duryee speaks of having been over the ground with a party of manufacturers and declares that the quantity and quality of the cement deposit is sufficient to warrant the building of the plant at once.

Outside Electrical Outlets for Portable Units

Outdoor portable electrically driven machinery is coming into wider and wider use in the non-metallic mineral industry as we all know, and it seems desirable that the trend of the future should be to increase this. The convenience and efficiency of this method of power utilization are closely akin to the benefits of individual motor drive in factory buildings.

Such outdoor use of electrical machinery of course means outdoor outlets and these may be of the very simplest kind or rather elaborate affairs which local conditions may or may not justify. The question of using flexible conductors which will give the least amount of trouble is also of first importance as no portable electrical tool can give any better service than its supply leads permit.

A very simple and apparently serviceable type of plug-in station was recently noted at the plant of the Berkshire Sand and Gravel Company at Lennoxdale, Mass. It is used for a small drag line scraper moved from place to place to make up surplus storage piles and its associated hoisting engine and motor mounted on a truck. The outlet simply consisted of four (the motor is 2-phase) 60 amp. porcelain fuse blocks fastened to a board nailed to a post or tree. There are five such stations. Leads from the overhead line wires are connected to the upper binding posts of the blocks and the motor leads to the lower binding posts. When the fuses are put in place the electrical circuit is complete. In this instance the motor leads are run through flexible conduit which for comparatively short runs is satisfactory. Of course, it affords good mechanical protection but is rather expensive to use on a large scale.

Value of Recording Instruments

By W. F. Schaphorst

Recording instruments are to be had for almost every purpose these days—for making graphical records of steam pressures, air pressures, and other pressures, temperatures of any thing under the sun, vacuum, speeds, water levels, etc. Even the night watchman's movements are commonly recorded on paper in a similar manner, to keep him from going to sleep while on duty. We are all more or less familiar with the CO_2 recorder. And so it goes all the way down the line.

There is no question but that these records are of great value to the engineer, superintendent, and owner. The superintendent or president can have all of the various gauges placed before his eyes over his desk, and thus he can keep in touch with every branch of his plant at all times. If something went wrong the week before at a certain time he can refer back to the records made at that time and perhaps deduce cause for the error or accident. Thus recently there was a disastrous boiler explosion in the South and it is "presumed" that the pressure ran too high. Nobody lives to tell about it. If the boiler plant had been provided with recording instruments there would be little question about the cause.

I was considerably interested not long ago in a record of the amount of power that was transmitted through a belt. A recorder gave the power that was being transmitted through the drive. The belt was slipping, however, and was not carrying as much power as was desired, so the superintendent decided that he would try covering the pulleys with canvas. He did so and the recorder immediately showed a "hump" at the point where the covering was applied, and from that time on there was no more slipping and full power was transmitted.

A little rough figuring proved to my own satisfaction that the belt had been slipping about 5 per cent. The covering reduced the slip to 2 per cent, which doubtless is due to the natural creep always to be found in a belt and which cannot be avoided. Hence the pulley covering caused a clear gain of 3 per cent of power without adding one whit to the load on the engine. Besides, it is quite possible that the belt will last long now that the slip is reduced 3 per cent. Friction is the thing that wears out belts, and the principal friction in a belt is that due to slip. On the other hand, it is better to avoid slip with out the use of covering if possible. I am opposed to coverings. A first class high friction belt should have been used. Coverings should be used only as a last resort.

Having never seen a record of this kind before, showing so clearly the benefits accruing from the stopping of belt slip, the writer thought it worthy of mention. It certainly should interest all engineers and belt operators.

Outdoor Plug-in Station for Two Phase Motor Mounted on truck with Hoisting Used with Dragline Scraper.

Recent Patents

1,631,182. Traction equipment for mobile machinery. Ralph I. Alexander, Kankakee, and Alfred H. Exton, Chicago Heights, Ill., assignors to Inland Engineering Co., Chicago, Ill.

1,631,183. Steering mechanism for mobile machinery. Ralph I. Alexander, Kankakee, and Alfred H. Exton, Chicago Heights, Ill., assignors to Inland Engineering Co., Chicago, Ill.

1,631,184. Mobile machinery. Ralph I. Alexander, Kankakee, Ill., assignor to Inland Engineering Co., Chicago, Ill.

1,631,233. Unit for crushing and distributing powdered stone in coal mines. Samuel Tescher, Denver, Colo.

1,631,313. Mine-car. Henry P. Field, Berwick, Pa., assignor to American Car & Foundry Co., New York, N. Y.

1,631,314. Mine-car. Henry P. Field, Berwick, Pa., assignor to American Car & Foundry Co., New York, N. Y.

1,631,320. Mine-car. Warren V. Johnson, Bloomsburg, Pa., and John L. McDowell, Jersey City, N. J., assignors to American Car & Foundry Co., New York, N. Y.

1,631,422. Attrition mill. Webster Lokem, Windom, Minn.

Gypsum Mined and Sold or Used by Producers in 1926

The gypsum industry in 1926 was not quite so productive as it was in 1925, according to a statement made public by the United States Bureau of Mines, Department of Commerce, based on reports received from 59 operators in 17 States and collected in co-operation with the Geological Surveys of Iowa, Kansas, Michigan, New York, Texas and Virginia.

The quantity of gypsum mined in the United States in 1926 was 5,635,441 short tons, a decrease of 42,861 tons, or less than 1 per cent, compared with 1925. This production, except for that of 1925, was the largest recorded and was twice as large as that of 1916.

The total value of the gypsum sold or used by producers was $46,721,219, a decrease of $856,021, or 2 per cent, compared with 1925. This was the largest value recorded except that in 1925. The quantity of gypsum sold by producers without calcining in 1926 was 961,363 short tons, a decrease of 52,772 tons, or 5 per cent, and was valued at $2,509,885, or $2.61 per ton; the quantity of calcined gypsum sold or used by producers was 4,015,974 tons, a decrease of 80,383, or 2 per cent, and was valued at $44,211,334, or $11.01 per ton.

New York continues to be the largest producer of gypsum. The production of crude gypsum in that State in 1926 was 1,723,460 tons, a slight decrease from that of 1925. This was nearly one-third of the entire quantity mined in the United States and more than twice as large as that of the second State, Iowa. New York is also the largest seller of gypsum, marketing 328,086 tons without calcining, or 34 per cent of the United States total, and 1,246,822 tons calcined, or 31 per cent of the total. These figures represent a decrease of 7 per cent in the uncalcined and an increase of 5 per cent in the calcined gypsum compared with 1925. Other important States in the production of crude gypsum in 1926 were Iowa, 802,910 tons; Michigan, 659,685 tons; Texas, 533,156 tons; Ohio, 521,205 tons; Nevada, 350,972 tons; and Oklahoma, 324,021 tons.

GYPSUM MINED AND UNCALCINED AND CALCINED GYPSUM SOLD OR USED BY PRODUCERS IN THE UNITED STATES IN 1926, BY STATES

State	Number of active plants	Total quantity mined (short tons)	Sold or used by producers				
			—Without calcining— Short tons	Value	—Calcined— Short tons	Value	Total Value
Iowa	7	802,910	129,803	$296,854	553,498	$ 6,291,349	$ 6,588,203
Kansas	3	195,440	47,641	108,792	111,174	1,111,928	1,220,720
Michigan	5	659,685	157,787	379,848	455,616	4,641,617	5,021,465
Nevada	5	350,972	52,642	102,282	218,670	1,424,953	1,527,235
New York	11	1,723,460	328,086	905,095	1,246,822	15,889,494	16,794,589
Ohio	3	521,205	13,082	38,788	509,522	5,758,433	5,797,221
Oklahoma	3	324,021	(***)	(***)	(***)	(***)	2,301,049
Texas	5	533,156	(***)	(***)	(***)	(***)	4,126,400
Utah	3	36,333	(***)	(***)	(***)	(***)	195,535
Other States**	14	488,259	*232,322	*678,226	*920,672	*9,093,560	3,148,802
	59	5,635,441	961,363	$2,509,885	4,015,974	$44,211,334	$46,721,219

*** Included under "Other States."
** Includes Arizona, California, Colorado, Montana, New Mexico, South Dakota, Virginia, and Wyoming.
* This figure includes also sales from Oklahoma, Texas, and Utah.

Attaching Service Wires to Buildings

The Figure 1 shows how power wires are attached to a building in what appears to be a rather complicated fashion but which is justified by the necessity of clearing obstacles and obviating undue strain at one point. The span from the pole line is rather long and the poles are high.

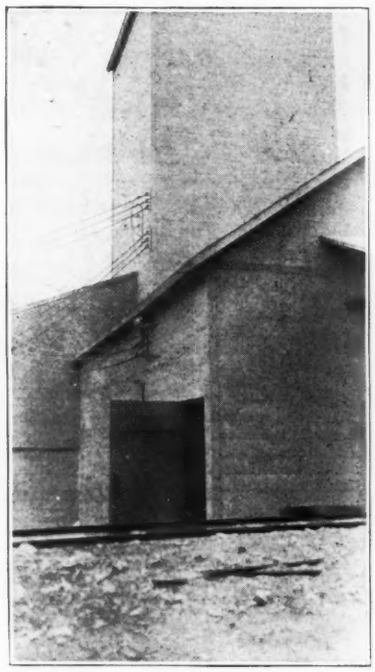


Figure 1.

The first point of attachment keeps the wires practically horizontal except for the natural sag. They are then dropped by means of jumpers to a lower point so as to shorten the span and decrease the decline to a point in the wiring of the building from which they are brought to the entrance. The latter is through a lead-in pot-head.

The controls for all the motors in the small plant are grouped on the wall just below the entrance. This method of control has been followed because the plant is run by one man who is stationed conveniently to this point.

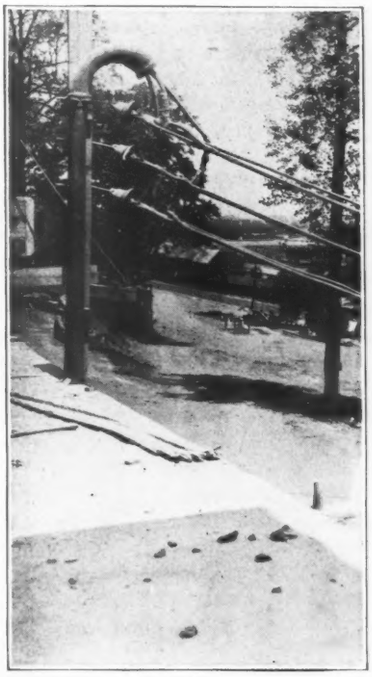


Figure 2.

Figure 2 shows how the wires from the secondary side of the outdoor transformer are brought into the building at the trap rock plant of Dyer and Kane at Ridgefield, N. J. The main switch and meter are located immediately below the conduit on the wall of the inside of the building. The span from the transformers being long and the wires of large size, there being two in parallel for each phase of the circuit, the strain is taken on strain insulators. Jumpers then run through the conduit into the building.

Putting Adjustable Shelves Into Wooden Storage Racks

In spite of the fact that the advantages of steel shelving for plant store rooms are widely recognized, and that over wood shelving steel will give upwards of 20 per cent additional storage space on the same floor area, literally hundreds of plants still use wooden shelving. One of the disadvantages of this type is its inflexibility. For the most part wooden shelves are not adjustable.

At one Indiana plant this problem was solved in a simple yet effective manner. The management did not feel justified in replacing their wooden racks with steel, but they did need adjustability in their shelves. That advantage was obtained by tearing out the permanent shelves in each bin, then bolting to the insides of the bins a series of angle iron strips (3 on each side) on which a steel shelf might rest or be slid into place.

Oil Electric Locomotives Solve a Problem

What is commonly known as the State Street and North Pier yard of the Chicago and Northwestern Railway Company is a section of great congestion. A 2-track line extends for a distance of 1¾ miles along a street that parallels the nearby Chicago River. Its northern terminus is at the Pugh Warehouse on the North Pier, Lake Michigan. At frequent intervals along the course of the yard, warehouses, manufacturing establishments, and other industrial and mercantile structures rise at the sides of the tracks. An almost continuous line of them exists on one side. Among them are buildings housing concerns of importance in the business world, such as Hibbard, Spencer & Bartlett; Reid, Murdock and Company; the Chicago Tribune, and others.

At various points, one or more branch out from the 2-track system to serve these establishments. In places a veritable maze of trackage exists. The system crosses numerous busy streets, including Michigan Avenue. The general traffic of these thoroughfares is carried overhead, but entryways are provided at the track level to permit trucks and teams access to cars and to the buildings fronting the tracks. The switching of cars within such a zone is fraught with difficulties. Because of the crossings and the traffic in the street, itself, a constant watch must be kept to avoid accidents.

After making a study of the situation, the Chicago, and Northwestern officials determined to try out some other form of locomotive than the familiar steam type and, in May, 1926, a 60-ton oil-electric locomotive began operations. Improved conditions were so immediately evident that another unit was placed in service in October, 1926; and in April, 1927, a third was added. This type of locomotive now handles all the switching in the State Street and North Pier yard.

The substitution of oil-electric for steam motive power units had effected a saving of approximately 50 per cent in operating costs, according to L. P. Michael, mechanical engineer of the road. Specific figures of comparison are not yet available because insufficient time has elapsed to arrive at the maintenance costs on the new locomotives.

There might be added some revealing benefits to the city. There is a gratifying absence of disturbing noises from puffing, exhausting steam, etc. Because of their swivel trucks, the oil-electrics round sharp curves silently, in contrast to the highly audible screeching set up by the steam-powered units and there is no smoke-making for greater personal comfort of those in the vicinity.

All three of the new locomotives are on duty continuously during 6 days of the week. On Sundays, one suffices for the switching requirements, and the two others are given a routine inspection on that day. Every three months, each is given a thorough inspection. No overhauling has been found necessary as yet.

The locomotives in use were built jointly by the American Locomotive Company, the General Electric Company, and the Ingersoll-Rand Company. Power from a 300h.p. oil engine drives a generator which supplies current to motors mounted on the trucks and geared to the driving axles.

The oil engine, which is manufactured by the Ingersoll-Rand Company, is of the 6 cylinder, vertical type. The fuel is fed to the cylinders by the solid injection method, and the prime mover is designed to make attainable in a notably high degree the efficiencies and economies which have been found possible with internal combustion engines using inexpensive oil for fuel.

The generator is direct-connected to the oil engine. It produces 200 kilowatts of direct current at 600 volts. Four 100-h.p. motors utilize the current, and these are mounted at points directly above the four driving axles. The General Electric Company produces all the electrical equipment. The American Locomotive Company manufactures the housing structure.

J. M. Allen Associated with Hetherington and Berner

Hetherington and Berner, of Indianapolis, have announced the association with their organization of Jean M. Allen, of Chicago, internationally known as a consultant, designer, engineer and builder of gravel pit and dredging equipment.

This combination between one of America's largest manufacturers in this field, and one of the leading engineers in the business, is one of the major developments of the year. Mr. Allen's experiences covers every phase of work in the sand and gravel industry, with which he has been actively connected since his boyhood. He has designed and built millions of dollars worth of dredging and pit equipment both in this country and abroad, and has been actively in charge of some of the greatest projects in the country's history.

Mr. Allen will continue his work as consulting engineer in Chicago, where he will also represent Hetherington & Berner in the design and sale of all the equipment they manufacture. In addition, the entire plant facilities of the Hetherington & Berner organization will be at Mr. Allen's disposal for the manufacture of the special equipment he develops. It therefore, is possible for an operator to have his entire plant equipment built under one roof, by a manufacturer boasting sixty years of successful experience.

How Best to Plug the Walls for Equipment Mounting

Frequently walls must be plugged in order to support fairly heavy weights such as motor starters, hangers, etc. And not infrequently such plugs shrink and become loose, with subsequent loss of service. This trouble may be largely avoided by making the plug in two parts. One of these is wedge shaped, while the other is forked and long enough to receive the entire length of the wedge. The forked section is not dissimiliar to the ordinary clothespin. Undercut the hole in the wall with a chisel so that it is slightly larger at the bottom than at the outer end. Place the wedge within the forked section, wedge-shaped portion inwards. Drive the plug in the hole until the blunt end is flush with the wall. Further hammering will now drive the wedge into the fork, thus expanding the plug to a tight squeeze. Such wall plugs seldom work loose.

Making the Hammer Head Fast

There is considerable annoyance and not a little risk attached to hammer heads coming loose on their handles while they are being used.

To correct this: Remove the wedge from the end of the handle that carries the head, and drive in its place a steel washer of at least equal thickness. When driven flush with the end of the handle, allow the whole to soak in water long enough to cause the wood to swell into the hole in the washer. This will permanently lock the washer into the wood and render it almost incapable of coming loose, regardless of degree of service.

The Galigher Company, 228 South West Temple St., Salt Lake City, Utah, is now a branch office of the Chain Belt Company. This office will handle the sale of Rex cains, transhmission machinery, Rex elevators and conveyors, and Rex traveling water screens in that territory. In addition, they will handle Stearns belt conveyors, which are manufactured by the Stearns Conveyor Company, recently purchased by Chain Belt.

NEWS OF EQUIPMENT MANUFACTURERS

Lincoln Electric Publishes Electric Welding Booklet

"Modern Manufacturing with a Stable-Arc Welder" is the title of a booklet recently issued by the Lincoln Electric Company. This book outlines briefly the theory of the use of arc welding in production manufacturing, and striking illustrations are reproduced showing recent applications of the process. The first part of the book is devoted to the replacing of iron castings by standard rolled steel sections joined by arc welding. There are numerous illustrations showing complicated machine parts, formerly cast, which are now built up in this manner. Also a number of typical machine parts.

In addition to economy, further advantages claimed for arc-welded steel construction are lighter weight, greater strength, elimination of patterns, reduction in material inventory and shorter time required for bringing out new designs. There are suggestions for redesigning cast parts for arc-welded steel construction and data on costs. One section of the book is devoted to arc welding in the tool room. Jigs, fixtures, punches, dies and strippers are illustrated which were made by this process at a great saving in weight and cost. Several types of "Stable-Arc" welding machines are illustrated and described.

Electric Haulage Equipment

Electrical haulage equipment for mines and industrial plants is described and illustrated in two new publications recently released by the Westinghouse Electric & Manufacturing Company. A 32-page book, S. P. 1774, entitled Baldwin-Westinghouse Mine and Industrial Electric Locomotives, contains performance, characteristics, electrical and mechanical equipment data and dimensions of twenty-five different types of trolley, storage battery and combination locomotives for mine and industrial plants. An illustration and plan and elevation drawing of each type accompanies these data.

A 4-page leaflet, L.20319—Selection of Electrical Equipment for Larry Cars contains a general description of a larry car and its equipment, a statement of the data required for selecting the electrical equipment, method of calculating power requirements, an outline of control requirements and a discussion of factors to be considered in the selection of the electrical equipment. An example of calculation of power requirements for a typical larry car problem is given.

New Universal Bulletin

The Universal Vibrating Screen Company, in an illustrated folder just issued, presents a score of highly commendatory letters from operators in various sections of the United States and Canada using from one to as many as thirty-six of the company's vibrating screens. The illustrations show views of some interesting installations.

Hyman-Michaels Appoints

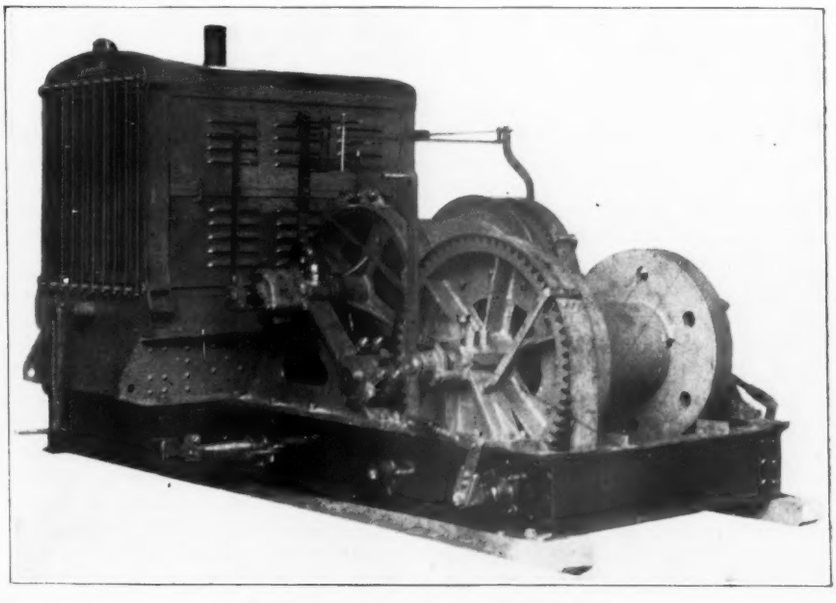
The Hyman-Michaels Company has appointed the Hofius Steel and Equipment Company of Seattle, Washington, as representative in Washington and the Northwestern territory. The Hyman-Michaels Company deal in new and relaying rails, logging and railroad equipment and heavy machinery and maintain large stocks at principal points on the coast and in the northwest.

R and S Rotary Car Dumper

Roberts & Schaefer Company illustrates in a folder recently issued the car-dumping and handling equipment formerly manufactured by the Car-Dumper and Equipment Company, which is now a part of the Roberts & Schaefer Company. There is no service that is harder on cars than that required at quarries, strip pits and cement plants, where steam and electric shovels are used for loading, and the great advantage claimed for the use of the rotary car dumper is that it makes possible the use of solid-body cars, thus reducing materially the maintenance cost on this class of equipment.

Large Scraper Hoist

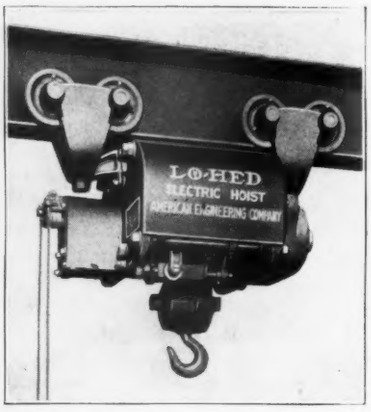
The illustration shows a large gasoline driven scraper hoist which was manufactured by the National Hoisting Engine Company. It is a 100 h.p. outfit arranged to handle a two-yard bucket with an in-haul speed of 200 feet per minute and an out-haul speed of 600 feet per minute. It is powered with a Waukesha 100 h.p. motor driving the hoist through a silent chain totally enclosed and running in a bath of oil. All the gears are steel with machine cut teeth, the pionions forged steel. Frictions are the double cone type with Asbesgraphite bands. The in-haul drum is equipped with a roller thrust which is claimed to be especially adapted for long heavy pulls as it eliminates the possibility of freezing of the friction pin to the friction key. The intermediate shaft has an out-board bearing so as to maintain alignment and give added strength to the intermediate shaft. Angle iron guards have been provided to prevent the ropes slipping off the drum. The entire outfit is mounted on an I-beam base. This type of outfit is made with either gasoline or electric drive for operating from ⅛ to 2 yard capacity scraper buckets.



Large Gasolene Driven Scraper Hoist.

New Lo-Hed Hoist

A motor trolley electric monorail hoist that operates in 15½ inches headroom is announced by the American Engineering Company as an addition to its line of Lo-Hed hoists. It is built in half ton and ton sizes and is similar in construction to the standard class A Lo-Hed hoist, except that it is mounted on an 8-wheel trolley that reduces the headroom requirement by more than 5 inches.



New Hoist

This hoist is made for operation with A. C. at 20 F.P.M. or D. C. at 20 to 40 F.P.M. and a special high-speed hoist provides for operation at 40 F.P.M. with A. C. and 40 to 80 F.P.M. with D. C. Standard height of lift is 20 feet but when required a lift of 25 feet can be provided. Remote control of both hoist and trolley can be provided.

This hoist travels around curves of short radius; shifts easily over switches and is protected from dust and moisture by metal covers. Motors are fully enclosed and the mechanical efficiency is over 80 per cent. Hyatt bearings are used on the gear shafts and in the trolley wheels and a ball bearing motor designed especially for hoist service is used. The drive between the motor and drum is of the spur gear type and runs in oil. Alemite lubrication is provided on all bearings not automatically lubricated by the oil bath. Holding and lowering brakes give full control of the hoist at all times and, combined with a positive acting upper limit device, insure safety in operation.

Zelnicker Issues Bulletin

Walter A. Zelnicker Supply Company has just sent out two interesting bulletins: Number 337 is devoted to rails, new and reconditioned, angle bars and splice bars, track spikes, track bolts, tie plates, and new and used switch material. Number 338 lists bargains in standard and narrow gage locomotives, shovels, motors, air compressors, boilers, tanks, etc.

Wilford Power Shovel Manual

The Universal Power Shovel Company has recently issued an engineering manual covering the Wilford power shovel and various attachments and interchangeable booms for the Wilford crane, clam shell, drag line and backfiller The book includes technical specifications, charts showing yardage and operating figures, at various lengths of boom. In addition, it gives data covering operation and maintenance

Speeder Convertible Excavator

Those who have need for a light yet highly efficient convertible shovel will be interested in the new catalog, recently issued by the Speeder Machinery Corporation, which describes and illustrates the Speeder convertible excavator with shovel, crane, dragline, pull shovel and skimmer attachments. The Speeder is of the full-revolving type, mounted on a crawler truck. It is self-contained, power being supplied either by a gasoline engine or an electric motor, and performs all operations of traveling, steering and rotating, as well as the digging and hoisting operations required of the various attachments named. The dipper on the shovel is of full half-yard capacity. Pull shovel buckets in the larger sizes are also of half-yard size; in the narrower sizes the capacity is slightly less. When operated as a clamshell or dragline, a half-yard bucket is used.

The Speeder is a one-man machine. The operator is provided with a seat, near the front of the cab, on the left side, with all the control levers before him as well as the engine throttle and switch, and with an unobstructed view of his work, whether making a shallow shovel cut or operating a high boom or crane work. The steel house is a complete enclosure, weather-proof and can be closed and locked when desired. It has three large doors and five window openings. The deck has pressed steel floor plates and there is ample room for greasing and adjustments.

The crawler is all-steel, with two speeds forward and two reverse. The machine steers from the cab, with cab in any position. A locking device prevents movement of the machine away from the work, yet allows travel towards it. The power plant has three steel drums, each 8 inches in diameter, with steel lagging to increase this to 11 inches for extra line speed. There are two operating speeds for the first two drums, the hoist drum being constant. The convertibility is complete, the machine operating as shovel, pull shovel, skimmer, crane, clamshell, dragline or backfiller.

Foos Engine Company Expands

At a recent meeting of the board of directors of the Foos Gas Engine Company, J. F. Baker was elected president and M. E. Baker, secretary-treasurer. It was also decided to change the name to "The Foos Engine Company." New department appointments have been made as follows: Ray C. Burrus, sales manager; W. W. Schettler, chief engineer, and George F. Noltoin, mechanical engineer. The new program of the company includes the establishment of a factory branch at Tulsa, Oklahoma, where a large stock of engines and parts will be carried. The staff at Tulsa will include sales representatives and service engineers.

Circular Steel Storage Bins

The Blaw-Knox Company has recently issued a folder describing its circular bins. These are of hopper-bottom construction, self-cleaning, quick dumping and, being all steel, tend to give long service without expense of interruption for repairs or rebuilding. The circular form eliminates all dead storage space, making them self-cleaning and the base of the bin terminates in a cone-shaped bottom from which is suspended a special Blaw-Knox roller bin gate which is guaranteed not to jam and which, being operated on rollers, will not wear out through friction. These bins are made in 85-ton, 135-ton, 210-ton and 300-ton sizes, and greater capacity can be obtained by one or more additional bins as the case may require.

New Lorain Shovel Bulletin

An illustrated bulletin recently issued by the Thew Shovel Company shows the Lorain center-drive shovels, draglines and clamshells—the Lorain 75 and the Lorain 60—as operated in various capacities and under a wide range of working conditions, from shifting sand to solid rock. Special attention is called to the Lorain 60, which is intended to meet the demands of those who do not require a 1¼ yard machine. It is the Lorain 75 in everything but dipper capacity, power plant, power take-off and counterweight, retaining all the strength and advantages of the 75, so that, if the purchaser should later require a 1¼ yard machine, it can be easily converted into a 75, thus securing the larger capacity without the necessity of disposing of the 1-yard machine to get it.

J. S. Schofield's Round Out Seventy-Five Years

On June 1, the firm of J. S. Schofield's Sons Co., passed its seventy-fifth anniversary. This company, which started in 1852 as a one man organization, has grown to be one of the largest firms of its kind in its section of the country. It comprises both manufacturing and mill supply departments and produces several machines and parts used in the pit and quarry industries.

The stroy of the development of this company was published in a special issue of the Macon Telegraph of June 1 in which appeared articles describing the various departments. In this issue are noted at some length some of the products of the company both in its early days and also modern times.

One of the first machines made was a hand power cotton press in the early 50's which was operated by slaves. A most interesting feature of the paper is also the good will which is expressed in it by other manufacturers who have had business dealings with them for many years as well as institutions and officials in the city of Macon.

The Dorr Washer

The Dorr Company, in Bulletin 4071, recently issued, describes and illustrates the Dorr washer, a three-product machine which produces from a mixed feed two grades of coarse material and an overflow carrying clay, silt and slimes. This machine was developed in the Minnesota iron ranges to simplify and improve the concentration or "beneficiation" of ores. Its successful operation in that capacity suggested its application in other fields, with the result that it has been applied successfully to washing lime marl for cement manufacture, phosphate rock, bauxite, diamonds, crushed stone, gravel, etc.

The Dorr washer, which is furnished in several sizes, with capacities ranging from 50 to 350 tons per hour, is described briefly as a washing barrel partially submerged in the low end of an inclined rectangular tank in which operates a reciprocating mechanism. Water is sprayed into the tank through a pipe running transversely across, near the center. The feed, usually screened through a grizzly with 6 inch openings, enters the washing barrel through a hollow trunnion at one end. The revolving action of the barrel cascades the feed, scrubbing off the adhering clay, slimes, etc., which, together with the fine sands, pass through the perforations in the barrel into the reciprocating rake department.

The clay and slime are thrown into the overflow which passes through openings in the end of the tank. The granular sandy material settles to the bottom of the tank and is advanced up the incline by the rakes. The spray washes out any trace of adhering slimes and the sands are then discharged in a clean, drained condition. The oversize material that does not pass the perforations in the washing barrel is advanced through the drum and, on reaching the discharge end, is picked up by a scoop, sprayed with clean water, and discharged in a slime-free, dewatered condition. The washing-barrel oversize and the rake discharge product may be mixed or kept separate, as desired.

New Dust Tight Compensator

To meet the demand for a small automatic compensator whose operation will not be affected by the dust prevalent in coal crushing plants and other similar places, the General Electric Company announces a device for low voltages, enclosed in a boiler plate case. This compensator has been given the General Electric designation CR-7051-J-2.

A standard automatic compensator is used in the construction, but the usual conduit box, wall support and top and front covers are omitted. The boiler plate case in which it is enclosed is made up as a unit with angles on which the compensator may be slid in or out. When the compensator is in position the angles can be raised to a vertical position, thus allowing the front door to close. An extra cable clamp is furnished with the compensator to hold the cables and to take the strain off the terminal board when the compensator is put into and taken out of the case.

The "All-Purpose" Crawler

In Bulletin B-10, recently issued, the Link-Belt Company presents a description of the Link-Belt "All-Purpose" crawler, as used with dipper shovel, grab bucket, trench shovel, crane and dragline boom, skimmer scoop, backfiller board, pile driver, wood grapple, lifting magnet, etc. This is a general utility machine, self-propelling and supplying its own track. The illustrations show typical applications in many fields of usefulness, and there are also detailed explanatory diagrams and ample mechanical data covering operating speeds, clearances, line pulls, etc. This machine is built in sizes up to 1¼ yards capacity and is furnished with either internal combustion or electric motor drive, as required. Machines are shipped assembled.

New Controller Finger

The General Electric Company has introduced a new hinged-type controller finger for railway and industrial haulage controllers which practically eliminates the trouble due to broken and bent fingers. Contact pressure is maintained by means of a rigid hinged arm and a spiral spring of steel. The arm carrying the tip is of steel, and will not bend or break. The hinge and seats rock on a steel tongue which is narrow enough to allow full-width contact through the alignment of tip and segment. This feature reduces heating and burning of both segments and tips, and greatly prolongs their life. The finger is equipped with a removable tip so that worn tips can be replaced. The new finger will shortly be furnished in all standard railway controllers, and is available for finger replacements on many old types of controllers.

New Bay City Bulletins

Bay City Dredge Works has recently issued two instructive bulletins, fully illustrated, showing machines in service as well as complete working range diagrams and specifications. Bulletin T-3 features the Bay City tractor shovel. This is a one-man operated convertible excavator, full-crawler mounted, using the International McCormick-Deering tractor for motive power. This tractor shovel operates ⅜-yard buckets, including shovel, clamshell, dragline, trench scoop or backfiller. It has three propelling speeds.

Bulletin 27 describes the model 16-B ¾-yard Bay City convertible excavator. This machine is featured with skimmer and trench scoops and also operates shovel, clamshell or dragline. It is an 18-ton machine, with gasoline power, one-man operated, with full crawler mounting, constructed entirely of steel, and, while featured for road and street excavation, sewer trench, etc., is suitable for a wide range of work.

Titgen-Eastwood Company Takes Over Paxson

The Titgen-Eastwood Company, a new incorporation, has taken over all the patterns and drawings of the J. W. Paxson Co., covering the complete line of Paxson foundry equipment. W. W. Titgen, A. B. Eastwood, Wm. Dunbar and C. Gunther, who constitute the new concern, were long connected with the Paxson Company and are therefore thoroughly familiar with all the details of foundry equipment. The offices and plant of the Titgen-Eastwood Company will be located at Luzerne and D Streets, Philadelphia, Pennsylvania.

Universal Turret Nozzle for Hydraulic Stripping

Operators of plants where surrounding conditions are such that a hydraulic method can be employed for stripping will be interested in a folder issued by the Universal Nozzle Company describing the Universal turret nozzle. This device presents many advantages, as regards simplicity, efficiency and economy of operation, over ordinary hose and nozzle. It does not have to be staked down or anchored in any way, requires no hose in its operation, being connected direct to the pipe line from pump, can be easily and safely operated by one man under various pressures, and the stream can be turned in any desired direction. It does not require any jacks or holders as does the ordinary hose pipe.

Because of the ease with which the stream may be deflected, it is possible, in stripping, after its action has loosened the overburden to keep it in suspension and moving to any desired place without settling. Thus, less water is needed to accomplish results, and there is corresponding saving of time and labor.

New Thread Pipe Coupling

The Farnstrom-Fons Company in a folder recently published describes and illustrates the Farnstrom-Fons pipe coupling, a device which can be used on new or old metal pipe, whether threaded or not, thus eliminating all threading or re-threading. Its use saves time and labor in constructing or tearing down a line, connections being made by simply laying the pipe in the coupling, driving in the key and then moving on to the next joint. It is claimed that with this coupling a pipe line may be run around a tree or over the roughest ground, uphill or downhill. It is guaranteed leakproof. The company also makes a special leak repair cover, which may be used in place of the top half of the regular coupling.

Oxwelded Pipe Lines

"Long Pipe Lines With Oxwelded Joints" is the title of a booklet which shows how engineers in the oil and gas industries have attacked and solved the problems of troublesome pipe joints. It quotes their own writings appraising the welded joint made by the oxy-acetylene process under proper procedure control. Welded pipe lines are relatively young, the first sizable gas line to attract general notice being put down to serve the San Francisco Fair. The first oil trunk line was oxwelded in 1920, but in seven years this method has been used in many installations.

Lincoln Electric Company Makes Changes

The Lincoln Electric Company announce the following changes and additions to their sales and service department: Mr. L. P. Henderson, formerly connected with the Detroit office, has been transferred to Chicago in charge of welder service. Mr. J. E. Durstine has been transferred from the experimental engineering department to the welder service department at Cleveland.

Mr. J. W. Shugars of the time study department at Cleveland, and Mr. R. D. Layman, also of Cleveland, have been moved to Detroit under the direction of Mr. J. M. Robinson. Mr. D. H. Carver has been transferred from the machine shop division at Cleveland to the Ohio service station division with headquarters at Cincinnati. Mr. R. F. Terrill has been transferred from general engineering department at Cleveland to the Eastern service division with headquarters at New York.

New Electrode Holder

With the coming of heavy current welding, new accessories have been found necessary in the arc welding lines of equipment. A 600-ampere metal electrode holder has recently been brought out by the Lincoln Electric Company which handles metal electrode in sizes up to ½ inch diameter and is known as type TR. Many improvements are claimed for this holder, among them being replaceable copper jaws, four-line contact for the electrode, all-copper path for welding current, structural steel construction (maximum strength), light weight with good balance, cool insulated and ventilated handle, and shield for protection of the operator's hand. In the handling of the heavy currents which are becoming common in manual metal electrode welding practice all of the features mentioned are of great importance.

Southern Equipment Bulletin

The Southern Iron and Equipment Company in their latest bulletin, recently issued, offer a number of interesting items, including standard gauge locomotives from 23 to 90-ton capacity; narrow gauge locomotives, 9-ton to 25-ton; flat cars, coaches, combination cars, camp cars, etc.; steam shovels, ¾-yard to 2½-yard; locomotive cranes, 8-ton and 21-ton; a railroad ditcher, ¾-yard dipper; standard gauge dump cars, 6 yards and 12 yards; 36-yard dump cars, 4-yard capacity, also locomotive and car repair parts, and relaying rails, 30 to 68-pound section, track materials, etc.

Columbus-McKinnon Chain Moves Its Offices

About the middle of July, the executive and general sales offices of the Columbus McKinnon Chain Company, now located in Columbus, Ohio, will be removed to Tonawanda, N. Y., at which point their large electric welding plant is located.

The Columbus, Ohio, factory will remain as a manufacturing unit as heretofore. Definite data of removal will be announced at a later date. The executive personnel of the company remains unchanged. The management state that the moving of the executive offices to Tonawanda, N. Y., will enable the company to render more prompt service on the majority of its products.

Booklet on Dry Grinding

The Hardinge Company, manufacturers of Ruggles-Coles dryers, Hardinge revolving stone screens, Hardinge clarifiers and continuous sand filters and Keystone lime kilns, announce the publication of a new booklet, bulletin No. 17A, on dry grinding with air classification. Among the subjects treated are: How to secure the finest possible product—Methods used to obtain a uniform granular product—Principle of reverse air currents and their effect on grinding capacity and economy—Methods employed to reduce moisture and how to grind products high in moisture without using a separate dryer. There are also operating data covering fifteen different cases as well as dimensions and layouts of this equipment.

Industrial Works Combine Two Southern Offices

The Industrial Works, manufacturers of shovels, cranes and draglines, equipped with crawler or rail mountings, announces the closing of their district office formerly located at 823 South Oregon Avenue, Tampa, Florida, effective immediately. The district office at Atlanta, Georgia, located in the Hurt Building, that city, will handle all of the business from Florida, Alabama, Georgia, North Carolina, South Carolina and the eastern portion of Tennessee.

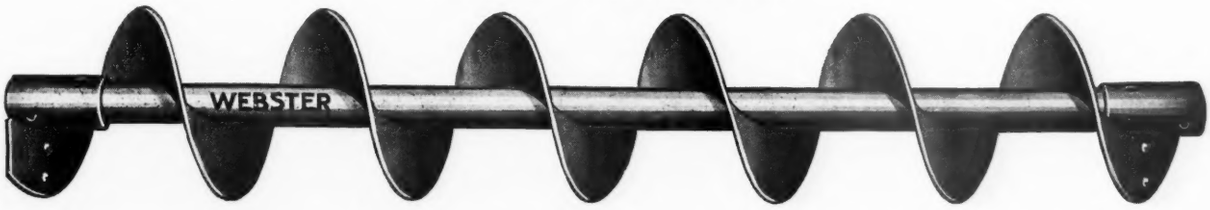
Bates Improves Bags

Bates Valve Bag Company illustrate, in an attractive leaflet, their 1927 improvement in the Bates Multi-Wall paper bag. This consists of a glued tape with reinforced elastic stitching top and bottom, adding one-third to the strength of this popular container.

WEBSTER

ELEVATING AND CONVEYING EQUIPMENT

SCREW CONVEYOR

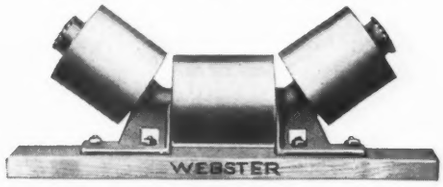


SECTIONAL FLIGHTS CUT FROM PLATE STEEL AND ROLLED TO FORM. UNIFORM IN THICKNESS FROM CENTER TO EDGE—THE GREATEST WEAR IS ON OUTSIDE EDGE. END FLIGHTS WHERE HEAVIEST DUTY IS PERFORMED ARE HEAVIER. DAMAGED FLIGHTS READILY REMOVED AND NEW FLIGHTS INSERTED.

ELEVATOR BUCKETS

STEEL AND MALLEABLE IRON BUCKETS IN ALL SIZES AND STYLES

CONVEYOR ROLLS

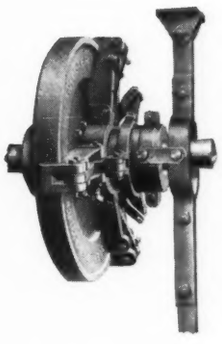


SEVERAL TYPES BELT CONVEYOR IDLERS FITTED WITH PLAIN, BALL OR ROLLER BEARINGS

CHAIN

A COMPLETE LINE OF CERTIFIED MALLEABLE IRON, COMBINATION AND STEEL CHAIN

FRICTION CLUTCHES



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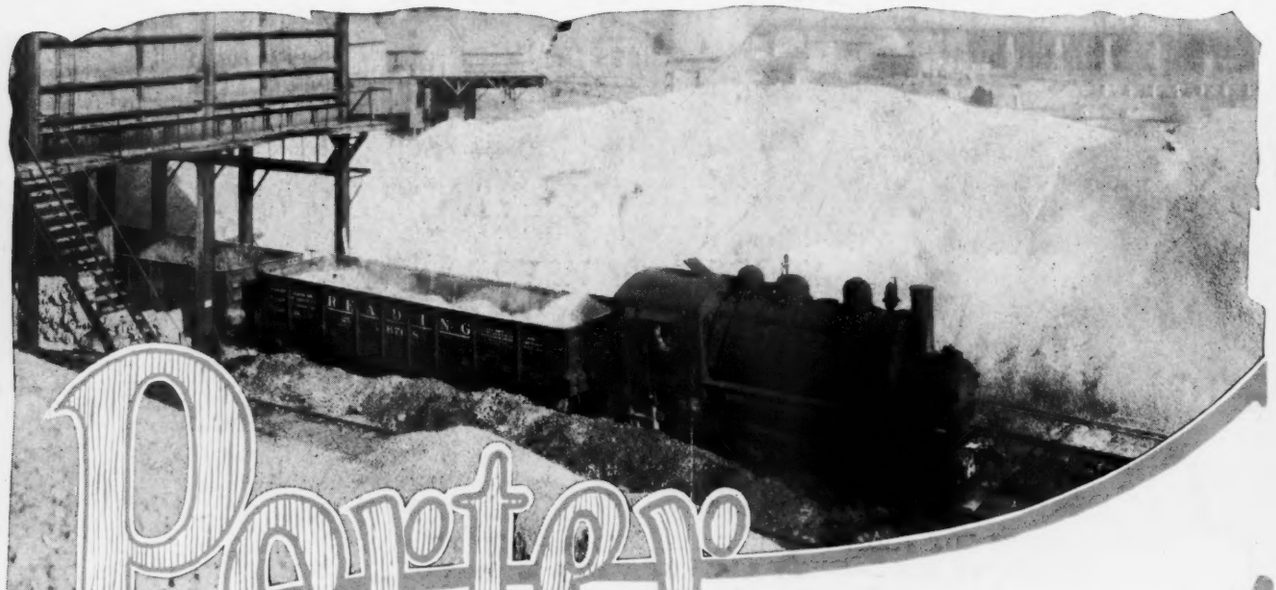

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